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## Marine Mollusks around Mishima and Tsunoshima Islands, Japan Sea Collected by the R/V *Tansei-Maru*

By

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**Abstract** Forty-seven noteworthy molluscan species from Mishima and Tsunoshima islands, Japan Sea off Yamaguchi Prefecture, are reported and illustrated. *Brookula tanseimaruae* is described as a new species. Eleven species are found to be new to Japan Sea, and eight that had been originally described from Mishima Island by Arthur ADAMS (1860–1865) but have never been collected therefrom up to date, were re-discovered from the type locality.

### Introduction

The first survey of marine mollusks on the continental shelf of the western Japan Sea was made by Arthur ADAMS with dredge of the R/V *Acteon* at the depth of 63 fathoms off Mishima Island, Yamaguchi Prefecture, in 1859. In this area he recognized 183 species, of which 163 were described as new species by himself during 1860 to 1865. His new species were neither illustrated nor measured in the original descriptions. Although only 73 species of them could be identified because of clear context in the original descriptions, the remaining 110 species were left as unidentifiable species (KURODA, 1948).

In the 20th century, the S/S *Soyo-Maru* of the Imperial Fisheries Experimental Station surveyed the continental shelf bordering Japan during 1922–1930. On this survey the dredge operations were carried out at 30 stations on the west of Oki Islands, the western Japan Sea. The mollusks collected by the *Soyo-Maru* survey were reported by HABE (1954, 1957, 1958a, b). Subsequently, TSUCHIDA and HAYASHI (1994) recognized 192 molluscan species from lower-sublittoral and bathyal zones off Cape Hinomisaki and Oki Straits in the biological materials collected by the R/V *Tansei-Maru*, Ocean Research Institute, University of

Tokyo. KAWAMOTO and TANABE (1956), IKEDA and TADA (1963), and TADA (1964) listed mollusks collected by A. ADAMS, the S/S *Soyo-Maru* and the other fishing boats from the Japan Sea off Yamaguchi Prefecture including Mishima Island. Intensive investigation on mollusks of the continental shelf around Mishima and Tsunoshima islands, however, has never been carried out since A. ADAMS in 1859.

Recently, the R/V *Tansei-Maru* collected mollusks in the area around the Mishima and Tsunoshima islands with dredge. The surveyed depth was 66–124 m on the continental shelf, or lower-sublittoral zone. A part of the mollusks collected by this survey, namely *Anatoma turbinata* (A. ADAMS, 1862), *Conrardia clathrata* A. ADAMS, 1860, and *Crossea miranda* A. ADAMS, 1865, etc. were already reported by TSUCHIDA (1991), TSUCHIDA *et al.* (1991b), TSUCHIDA and SUGIMURA (1992), and HORI and TSUCHIDA (1994).

This paper gives taxonomical account with their distribution on the noteworthy species including those new to the Japan Sea. A new species belonging to the Skeneidae and ADAMS' species that were rediscovered by this study are described and illustrated here.

### Materials and methods

Tsunoshima Island is situated at a distance of 5 km from the western tip of Honshu, and it is elongate in east-west direction having about 16 km in circumference (Fig. 1). Mishima Island is situated at about 45 km northwest off Hagi City, and it tapers northerly and widens southerly having about 18 km in circumference (Fig. 1). The dredge operations were carried out at 2 stations off Tsunoshima Island and at 6 stations off Mishima Island (Table 1).

The dredge (Ocean Research Institute, University of Tokyo type; ORI dredge 1 m span, 5 × 5 mm mesh of the codend) was dragged for about 5 minutes after it reached to the bottom. However, at the station CB-0 and CB-1, it was dredged for only 1 minute because the fuse wire was cut in an accident. The dredged samples were shieved through 1 mm mesh on deck, and sorted carefully there or in the laboratory.

The type specimen of the new species described in this paper is deposited in the Natural Science Museum, Tokyo.

Synonymies are given to selected species of which nomenclatorial status has been subtle.

Abbreviations: SL(L) = Shell length; SW(W) = Shell width; NSMT = National Science Museum, Tokyo; CBM = Natural History Museum and Insitute, Chiba.

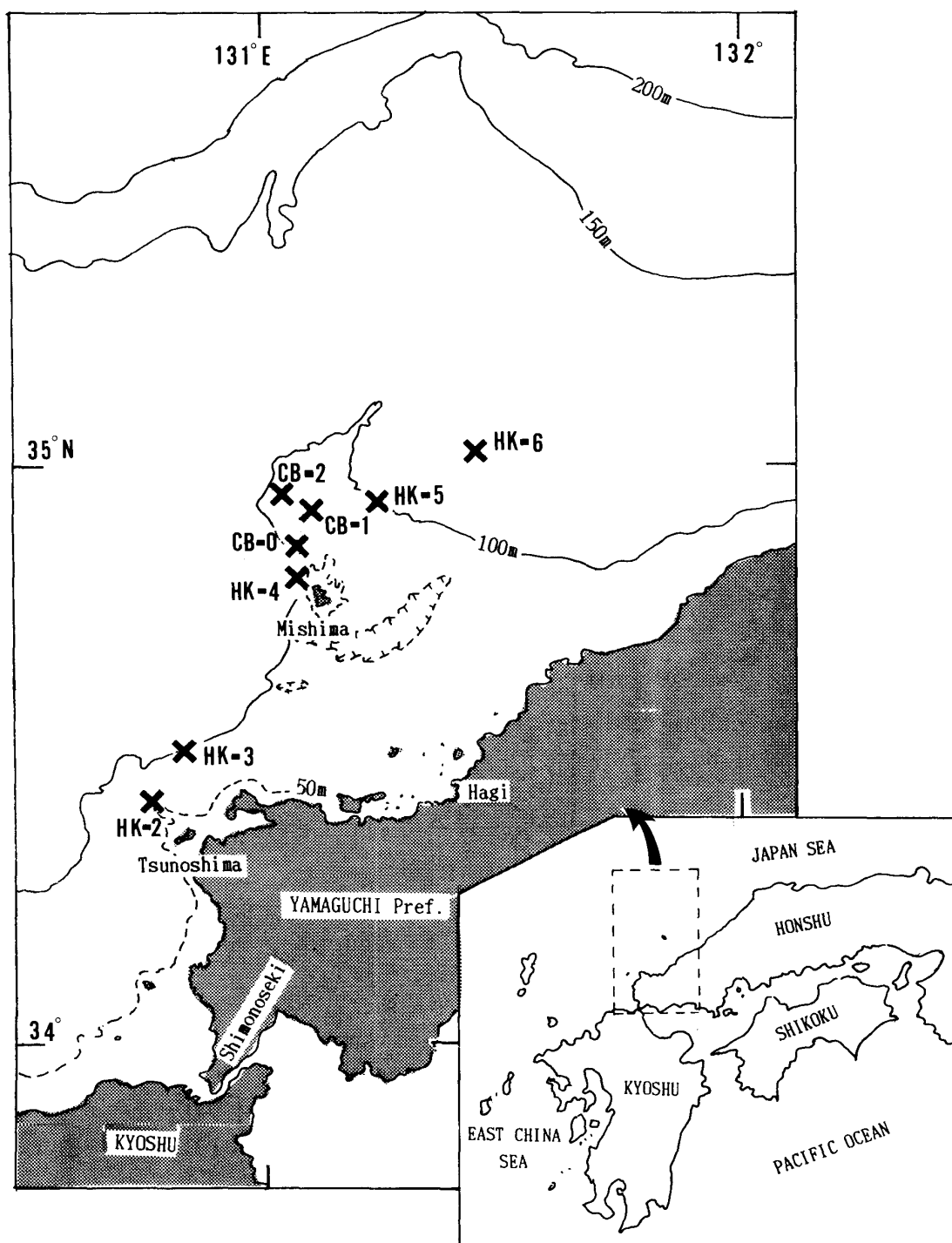


Fig. 1. Dredging stations by the R/V *Tansei-Maru* (KT-90-15 cruise).

Table 1. Dredging stations off Mishima and Tsunoshima by the R/V *Tansei-Maru* (KT-90-15 cruise).

Station	Data and Time	Position		Depth (m)	Sediment
		N. lat.	E. long.		
St. HK-2	Oct. 29, 19:40–19:47	34°25.2–34°25.2	130°46.8–130°46.6	86–88	Sand
St. HK-3	Oct. 29, 20:51–21:02	34°30.1–34°30.2	130°52.2–130°52.3	93–95	Sand
St. HK-4	Oct. 29, 23:53–24:00	34°50.3–34°50.4	130°05.3–130°05.4	93–96	Sand
St. HK-5	Nov. 02, 10:08–10:17	35°55.1–35°55.2	131°18.7–131°18.6	97	Sandy Mud
St. HK-6	Nov. 02, 08:00–08:11	35°02.9–35°03.0	131°31.0–131°30.4	124	Sandy Mud
St. CB-0	Nov. 02, 17:37–17:40	34°52.9–34°52.9	131°10.6–131°10.6	66	Coarsesand & Gravels
St. CB-1	Nov. 02, 16:14–16:18	34°54.5–34°54.4	131°07.6–131°07.5	70–71	Coarsesand & Gravels
St. CB-2	Nov. 02, 14:02–14:13	34°58.8–34°58.1	131°04.8–131°05.6	74–78	Coarsesand & Gravels

### Systematics

Phylum MOLLUSCA CUVIER, 1797

Class GASTROPODA CUVIER, 1797

Order VETIGASTROPODA SALVINI-PLAWEN, 1980

Family Scissurellidae GRAY, 1847

*Anatoma lamellata* (A. ADAMS, 1862b)

(Pl. 1, Figs. 1a, 1b)

[Japanese name: Kodemari-Kuchikire-Ebisu-Gai]

*Anatomus lamellatus* A. ADAMS, 1862b, p. 347.

**Materials examined.** 4 specimens, NSMT-Mo 70700 (St. HK-3).

The shell is obese biconical ( $W/L=1.1$ ), somewhat thin, and opaque. The protoconch has 1.5 whorl with numerous fine irregular dots on its whole surface and a raised spiral keel on its adapical part, but vanishing abapically. Teleoconch whorls are 4 in number, somewhat convex. At lower 1/3 part of each whorl is present a well-defined spiral groove, of which margins are lamellarly and sharply protruded. The inside of the spiral groove is sculptured by fine longitudinal lirae. Surface except of the spiral groove is marked by longitudinal ribs and spiral lirae, presenting a reticulated sculpture. The longitudinal ribs are thin, slightly lamelated and flexuous, about 50 in number on the body whorl. The interspaces of the ribs are about thrice as wide as the ribs themselves, and sculptured by fine growth lines. The spiral lirae are narrow, feebler than longitudinal ribs, about 10 in number above spiral groove. The width of interspaces of spiral lirae are partly

irregular, but generally about 2 to 3 times as wide as lirae. The periphery of the body whorl is rounded. The adapical part to spiral groove including the base of the body whorl bears longitudinal ribs and about 20 spiral lirae. The strength and condition of the interspaces of them are nearly the same to those of the adapical part of each whorl. The umbilicus is wide and deep, of which inside is also sculptured by longitudinal ribs and spiral lirae. The aperture is circular. The columella is slightly concave, with lamellate callus which is continuous to the inner lip. The outer lip is somewhat thin. The spiral groove near the outer lip is incised for about  $1/6$  to  $1/7$  of turn.

*Remarks.* Although *Anatoma japonica* (A. ADAMS, 1862) resembles this species, the former differs from this species in having about 25 spiral lirae above the spiral groove, and much finer and denser longitudinal ribs. The type locality of this species is off Mishima Island, Yamaguchi Prefecture (A. ADAMS, 1862b). Although TSUCHIDA *et al.* (1991) already described in Japanese with the drawing of the present specimen, in this paper it was again described in English with the photographs above.

#### Family Trochidae RAFINESQUE, 1815

#### *Calliostoma sakashitai* (SAKURAI, 1994)

(Pl. 1, Figs. 2a, 2b, 2c)

[Japanese name: Miura-Ebisu-Gai]

*Tristichotrochus sakashitai* SAKURAI, 1994, pp. 288–289, 294, fig. 7.

*Calliostoma sakashitai*: HASEGAWA and SAITO, 1995, pp. 17, 33, pl. 2, fig. 5.

*Material examined.* 1 specimen, NSMT-Mo 70701 (St. HK-2).

The shell is small for the genus, high conic ( $L/W=1.2$ ), thick, slightly polished, and pale yellowish brown. The protoconch is white and smooth, with 1.5 whorl. Teleoconch whorls are 9.5 in number, with feebly convex walls. The peripheral part of each whorl are decorated by several irregular red-brown speckles. Surface is ornamented by narrow and granulated spiral lirae, 10–12 in number on the body whorl, colored by alternating red-brown and pale yellow dots. Although strength of lirae are not equal to each other, those situated on adapical  $1/3$  and abapical  $1/3$  part of each whorl tend to be stronger than the others. Interspaces of lirae are nearly equal to or slightly wider than lirae. The periphery of the body whorl is somewhat angulated. The base is flat, sculptured by 12–13 narrow and granulated spiral lirae. There is no umbilicus. The aperture is quadrate-oval. The columella is thick and slightly concave. The inner lip is covered by a thin callus. The outer lip is thick.

*Remarks.* The specimen is slightly smaller than the type specimen (NSMT-Mo 70284). This species is closely similar to *C. aculeatus* SOWERBY, 1912 but the

latter has stronger granules on spiral lirae and more angulated whorls. Although the type locality of this species had been originally designated as off Yamakawa, Kagoshima Prefecture (SAKURAI, 1994), later it was corrected to off Jogashima, Sagami Bay (HASEGAWA & SAITO, 1994). This is first record of this species from the Japan Sea and the second record of this species.

Family Skeneidae CLARK, 1851

*Conradia clathrata* A. ADAMS, 1860a

(Pl. 1, Figs 3a, 3b; Pl. 4, Figs. 2a, 2b)

[Japanese name: Warabe-Shitadami]

*Conradia clathrata* A. ADAMS, 1860a, p. 410.

*Conradia* sp. Tsuchida *et al.*, 1991, pp. 15–16, pl. 3, fig. 2.

*Material examined.* 1 specimen, NSMT-Mo 70702 (St. CB-2).

The shell is turbate ( $L/W=1.2$ ), thick, somewhat polished, and opaque. The protoconch is entirely smooth, with 1.5 whorl. Teleoconch whorls are 4 in number, with convex walls, separated by distinct and constricted sutures. Surface is ornamented by longitudinal ribs and spiral keels, presenting reticulated sculpture. Longitudinal ribs are conspicuous and somewhat flexuous, about 45 in number on the body whorl. Interspaces of ribs are smooth and about twice as wide as width of ribs. Spiral keels are 3 in number, encircling the adapical about  $2/5$ , the abapical about  $1/3$  part and the periphery. They are nearly equal to each other, acutely well-developed, overriding and stronger than longitudinal ribs. The periphery of the body whorl is convex. The base is sculptured by longitudinal ribs continueing from the adapical part of the body whorl and 4 additional spiral keels, of which, the upper 2 are as strong as longitudinal ribs, while the abapical 2 are as strong as those on the adapical part of the body whorl. On the surface near the outer lip, the longitudinal ribs are occasionally fused forming a strong and high varix. Interspaces of ribs are obviously and longitudinally sculptured by growth lines. The umbilicus is somewhat wide and deep, margined by a very highly raised and strong fasciole. The inside of the umbilicus and the umbilical fasciole are densely crenulated by well-defined growth lines. The aperutre is circular. The columella is thick and concave. The columella, the inner lip and the outer lip are continuously covered by a thick and polished callus. The margin of the outer lip possesses 6 small projection that are extremities of spiral keels.

*Remarks.* The type locality is Korea Straits (A. ADAMS, 1860a). This species has been reported also from Wakasa Bay (KANEKO, 1989), and Toyama Bay (ITO, 1986).

*Lissostesta japonica* (A. ADAMS, 1861b)

(Pl. 4, Figs. 1a, 1b)

[New Japanese name: Hatoko-Shitadami]

*Adeorbis japonica* A. ADAMS, 1861b, p. 246.

**Materials examined.** 2 specimens, NSMT-Mo 70703 (St. HK-2).

The shell is planoid ( $W/L=1.5$ ), thick, white and somewhat translucent. Teleoconch whorls are 4 in number, with slightly convex walls, and separated by feebly constricted sutures. Surface is marked by coarse and obliquely flexuous growth lines. The periphery of the body whorl is strongly rounded. The base is relatively flat, sculptured only by fine growth lines. The umbilicus is very large and deep, occupies about  $1/4$  of diameter of the base. The margin of the umbilicus is roughly crenulated. The aperture is oval. The columella is thick and slightly concave. The columella, the inner lip and the outer lip are continuously covered by a thick callus. The adapical end of the outer lip produces anteriorly.

**Remarks.** Although this species resembles *L. sobrina* (A. ADAMS, 1861), the shell is higher with wider umbilicus in comparison with the latter. HABA (1985) illustrated the syntype specimens of this species. The type locality of this species is off Mishima Island (A. ADAMS, 1861b). This is the first re-discovery of this species.

*Brookula tanseimaruae* sp. nov.

(Pl. 1, Figs. 4a, 4b)

[New Japanese name: Tansei-Itokake-Shitadami]

**Material examined.** 1 Holotype, NSMT-Mo 70704 (St. HK-3).

The shell is somewhat helicoid ( $L/W=1.0$ ), thin, and opaque white. The protoconch has 1.5 whorls with 6 to 7 obsolete and thin spiral lines. The interspaces of these spiral lines are wide and nearly equal in width to each other. The whorls of the teleoconch are 2 in number, with rounded walls. Surface is ornamented with pronounced and acute longitudinal ribs, 25 in number on the body whorl. Interspaces of longitudinal ribs are 4 to 5 times as wide as the width of ribs, sculptured by very fine growth lines and 4 spiral lirae. These spiral lirae are narrow, much feebler than longitudinal ribs, and their interspaces of them are about 4 to 5 times as wide as lirae. On the adapical part of each whorl the spiral lirae become fainter and indistinct. The periphery of the body whorl is well-rounded. The base has longitudinal ribs continuous from the adapical part of the body whorl with 4 to 5 spiral lirae. Of these spiral lirae, the abapical ones become stronger and nodulated by crossing with longitudinal ribs. The umbilicus is wide and deep, sculptured by dense and obsolete longitudinal ribs and about 3 feeble

spiral lirae. The aperture is circular. The columella carries of lamellated callus, which is continuous to the whole margin of the aperture. The outer lip is somewhat thin.

*Type locality.* Off Tsunoshima Island 93–95 m depth, Yamaguchi (KT-90-15, St. HK-3).

*Remarks.* Although this new species resembles *Brookula stibarochila* WARÉN, 1991 from Kermadec, the latter differs from the former in having entirely smooth protoconch, decidedly angulated whorls, lamellated longitudinal ribs, much wider interspaces of longitudinal ribs, and many distinct spiral lirae in interspaces of ribs.

## Order NEOTAENIOGLOSSA HALLER, 1882

### Family Rissoidae GRAY, 1847

#### *Microstelma japonica* (A. ADAMS, 1860a)

(Pl. 1, Figs. 5a, 5b)

*Macrocheilus japonicus* A. ADAMS, 1860a, p. 407.

?*Amaurella japonica*: THIELE, 1929, p. 260, fig. 274; WENZ, 1941, p. 1035, fig. 2964.

*Microstelma japonica*: PONDER, 1985, p. 97, fig. 67.

*Materials examined.* 4 specimens, NSMT-Mo 70705 (St. HK-2); 1 specimen (St. HK-4).

The shell is ovate ( $L/W = 1.7$ ), thick, feebly polished, and opaque white. The protoconch is globular and smooth. The whorls of the teleoconch are 6 in number, convex, separated by distinct and deep sutures. The walls are feebly and narrowly angulated immediately under sutures. Surface is marked by distinct and slightly flexuous growth lines. The body whorl is large and swelled, occupies about  $2/3$  of the shell length, with convex periphery. The umbilicus is narrow, fissurate, with feebly angulated margin. The columella is thick and slightly concave. The outer lip is thick, and its anterior part presents an indistinct shallow and wide anterior canal. A polished and continuous callus covers the columella, the inner lip and the outer lip.

*Remarks.* Although the protoconchs of the present specimens could not be observed, PONDER (1985) described that the protoconch of this species from Australia possesses 2 whorls.

THIELE (1929) doubtfully included *Amaurella* into the genus *Acrybia* in a section of the Naticidae. WENZ (1941) supports Thiele's assignment, and included this species into the genus *Bulbus* (Syn. *Acrybia*). Later, PONDER (1985) removed this species from the Naticidae to *Microstelma* of the Rissoidae.

OYAMA (1969) illustrated a similar specimen to this species as *Amaurella japonica*, and gave it a Japanese name "Otohime-tamagai". However, his speci-



men accords with neither the type specimen photographed by THIELE (1929) and WENZ (1941) nor the present specimens. Consequently, this species is presumably not identical with Oyama's specimens.

The type locality of this species is Korea Straits (A. ADAMS, 1860a).

***Rissoina (Phosinella) sculptilis* GARRETT, 1873**

(Pl. 1, Figs. 6a, 6b, 7a, 7b)

[Japanese name: Ibo-Choji-Gai]

*Rissoina sculptilis* GARRETT, 1873, p. 209, pl. 2, fig. 2; TRYON, 1887, p. 383, pl. 58, fig. 5.

*Rissoina (Phosinella) sculptilis*: CERNOHORSKY, 1984, p. 47, pl. 12, fig. 6.

*Rissoina sincera* MELVILL and STANDEN, 1896, p. 308, pl. 11, fig. 66.

*Rissoina (Phosinella) clathrata*: LADD, 1966, p. 68, pl. 12, fig. 37.

**Materials examined.** 1 specimen, NSMT-Mo 70706 (St. HK-2); 1 specimen, NSMT-Mo 70707 (St. CB-0).

The shell is oblong ovate ( $L/W=2.1$ ), thick, polished, and opaque white. 5 whorls of the teleoconch are preserved, while the apex is lost. Teleoconch are feebly convex and angulated at their adapical and abapical parts. The suture is deep and distinct. Surface is ornamented with conspicuous and flexuous longitudinal ribs, 22–23 in number on the body whorl. Interspaces of longitudinal ribs are more or less wider than ribs, and sculptured by fine growth lines. These ribs are crossed by 3 strong spiral keels, forming nodulated sculpture on the junctions of both. The spiral keels are narrower and slightly feebler than the longitudinal ribs. The adapicalmost one of these keel is weaker than the others. Interspaces of spiral keels are 3 to 4 times as wide as keels. The periphery of the body whorl is convex. The base has 2 spiral keels and longitudinal ribs continued from the adapical part of the body whorl. In this region, spiral keels are as strong as longitudinal ribs, and their interspaces are twice to thrice as wide as the latter. There is no umbilicus. The columella is thick and oblique. The aperture is ovate. The outer lip is thick and crenulate due to spiral keels. The anterior part of the aperture has a distinct and wide anterior canal. A heavy continuous callus covers the columella, the inner and the outer lips.

**Remarks.** Although TRYON (1887) synonymized this species with *Rissoina (Phosinella) granulosa* PEASE, 1862, the latter is not identical with this species because of difference in size (SL of the latter: 2.0 mm) and shell sculpture. LADD (1966) illustrated two specimens of *R. (P.) clathrata* A. ADAMS, 1853 from New Hebrides Islands. However, one of them (LADD, 1966: pl. 12, fig. 37) is not identical with *R. (P.) clathrata*, but agrees with this species, because it has no nodulated sculpture of the shell. In Japan, KURODA (1928) first reported this species from Amami-Oshima Island, while KURODA and HABE (1952) treated this species a synonym of *R. (P.) granulosa*. Recently 3 specimens of this species

were collected from depth of 10 m, Nakagusuku Bay, Okinawa (KUBO, pers. comm.) and one off Okinawa Island (KUROZUMI, pers. comm.). The specimens under the present study are larger than those specimens from Okinawa area. This is the first record of this species from the Japan Sea.

Family Ovulidae FLEMING, 1822

*Dentiovula colobica* AZUMA et CATE, 1971

(Pl. 2, Figs. 2a, 2b, 2c)

[Japanese name: Koboreba-Kebori-Gai]

*Dentiovula colobica* AZUMA and CATE, 1971, p. 263, fig. 5.

*Material examined.* 1 specimen, NSMT-Mo 70708 (St. CB-0).

*Remarks.* This species has been known in the south to Sagami Bay on the Pacific coast of Japan and feeds on gorgonians, *Acalycigoragia inermis* or *Acalycigoragia* spp. (MASE, 1989). This is the first record of this species from the Japan Sea.

*Phenacovolva tayloriana* AZUMA et CATE, 1971

(Pl. 2, Figs. 3a, 3b)

[Japanese name: Tairo-Kinudutsumi-Gai]

*Phenacovolva tayloriana* AZUMA and CATE, 1971, p. 265, fig. 10.

*Material examined.* 1 specimen, NSMT-Mo 70709 (St. CB-0).

*Remarks.* This species has been known in the south to Kii Peninsula on the Pacific coast of Japan (HIGO & GOTO, 1993), and this is the first record of this species from Japan Sea.

Family Epitoniidae BERRY, 1910

*Nodiscala mormulaeformis* MASAHIITO, KURODA et HABA, 1971

(Pl. 2, Figs. 6a, 6b)

[Japanese name: Choji-Fusi-Itokake-Gai]

*Nodiscala mormulaeformis* MASAHIITO, KURODA and HABA, 1971, pp. 396–397 (Jap.), 248 (Eng.), pl. 63, fig. 1.

*Material examined.* 1 specimen, NSMT-Mo 70710 (St. HK-2).

*Remarks.* This species is distributed in the south to Sagami Bay, and on the Pacific coast of Shikoku and Kyushu (KURODA *et al.*, 1971). From the Japan Sea this species has hitherto been known from Noto Peninsula (ITO *et al.*, 1986) and off Sado Island (ITO, 1989).

*Cirsotrema plexis* DALL, 1925

(Pl. 2, Figs. 7a, 7b)

[Japanese name: Hosō-Chirimen-Nina]

*Cirsotrema plexis* DALL, 1925, pp. 10–11, pl. 21, figs 12, 12a.*Material examined.* 1 specimen, NSMT-Mo 70711 (St. CB-2).*Remarks.* This species is distributed in the south to Boso Peninsula, and the Pacific coast of Shikoku and Kyushu (KURODA *et al.*, 1971). This is the first record of this species from the Japan Sea.*Elegantiscala fimbriatula* MASAHIITO, KURODA *et* HABE, 1971

(Pl. 2, Figs. 8a, 8b)

[Japanese name: Chijiwa-Itokake-Gai]

*Scala fimbriata* A. ADAMS, 1861d, p. 480. (non. LAMARCK, 1816); HABE, 1985, pp. 10–11, pl. 2, fig. 5.*Cirsotrema (Elegantiscala) fimbriatum* KURODA and HABE, 1954, p. 5, pl. 1, fig. 5.*Elegantiscala fimbriatula* MASAHIITO, KURODA and HABE, 1971, pp. 400 (Jap.), 250 (Eng.), pl. 62, figs. 6, 7.*Material examined.* 1 specimen, NSMT-Mo 70712 (St. HK-2).*Remarks.* This species was originally described from 63 fathoms deep off Mishima Island by A. ADAMS (1861d). However, the name by him was preoccupied by *Scala fimbriata* LAMARCK 1816, consequently KURODA and HABE (1954) introduced a new substitute name, *Elegantiscala fimbriatula* for this species. HABE (1986) illustrated one of the syntype specimens of this species. This species is distributed in the south to Sagami Bay, Shikoku, and Kyushu (KURODA *et al.*, 1971). This is the first re-discovery of this species from the type locality.*Amaea* cf. *lixa* (IREDALE, 1931)

(Pl. 2, Figs. 9a, 9b)

*Materials examined.* 3 specimens, NSMT-Mo 70713 (St. HK-4).The shell is tall, conic ( $L/W=2.8$ ), thick, and opaque white. The protoconch is lost. Teleoconch whorls are 9 in number, with convex wall, separated by distinct and constricted sutures. Surface is ornamented by obsolete longitudinal ribs which occasionally fuse to each other forming wide and low varices, fine flexuous growth lines and 6 to 7 low and indistinct spiral keels. Spiral keels are narrow on the adapical part of each whorl, while they become wider on the middle to abapical part where keels are twice to thrice as wide as those on the adapical part. Interspaces of spiral keels are nearly equal to or twice as wide as keels,

sculptured by dense and fine longitudinal lirae. On the adapical whorls, spiral keels become obsolete and indistinct. The periphery of the body whorl is feebly angulated. The base has 4 to 5 spiral keels and fine longitudinal lirae as well as the adapical part of the body whorl. There is no umbilicus. The aperture is ovo-quadrangle. The columella and the inner lip are covered by thin callus. The outer lip is thick.

*Remarks.* This species closely resembles *Amaea lixa* (IREDALE, 1931) from 70 fathoms deep off Green Cape, New South Wales, Australia. The final identification needs the type material of this species.

***Fragilopalina nebulodermata* AZUMA, 1972**

(Pl. 2, Figs. 10a, 10b)

[Japanese name: Kumori-Habutae-Itokake-Gai]

*Fragilopalina nebulodermata* AZUMA, 1972, p. 57.

*Material examined.* 1 specimen, NSMT-Mo 70714 (St. HK-2).

*Remarks.* This species is distributed from Kii Peninsula to off southwestern Taiwan (AZUMA, 1972). This is the first record of this species from the Japan Sea.

***Viciniscala liliputana* (A. ADAMS, 1861d)**

(Pl. 2, Fig. 11)

[Japanese name: Kobito-Itokake-Gai]

*Scala liliputana* A. ADAMS, 1861d, p. 481.

*Material examined.* 1 specimen, NSMT-Mo 70715 (St. HK-2).

*Remarks.* The type locality of this species is off Mishima Island. This species is distributed in the south to Sagami Bay, and the Pacific coast of Shikoku and Kyushu (KURODA *et al.*, 1971).

***Papyriscala* sp.**

(Pl. 2, Figs. 12a, 12b)

*Materials examined.* 1 specimen, NSMT-Mo 70716 (St. HK-2); 1 specimen (St. HK-4).

The shell is ovate ( $L/W=2.1$ ), somewhat thin, polished, and opaque. 2 quite indistinct brown bands are visible on the adapical part and middle part of each whorl. The protoconch is fractured. Teleoconch whorls are 5 in number, with convex walls, separated by well-constricted sutures. Surface is ornamented by distinct and lamellated longitudinal ribs 22 in number on the body whorl. Some

of them fuse to each other forming thick varices from place to place. Interspaces of ribs are twice to thrice as wide as ribs, with microscopic growth lines. The periphery of the body whorl is rounded. The umbilicus is very narrow. The aperture is circular. The columella is covered by lamellated callus, which is continuous to inner and outer lips. The outer lip is somewhat thick.

*Remarks.* This species is closely related to *P. tenuilirata* (SOWERBY, 1874) and *P. emiliae* (MELVILL et STANDEN, 1903), although it differs from the latter two in width of the shell and number of longitudinal ribs. *P. imperialis* (SOWERBY, 1844) is different from this species because of its finer longitudinal ribs and overall pale brown coloration without forming band.

#### Order NEOGASTROPODA THIELE, 1929

#### Family Buccinidae RAFINESQUE, 1815

#### *Nassarius (Zeuxis) protrusidens* (MELVILL, 1918)

(Pl. 2, Figs. 1a, 1b)

[Japanese name: Shikoro-Mushiro-Gai]

*Alectryon (Hima) protrusidens* MELVILL, 1918, p. 140, pl. 4, fig. 3.

*Zeuxis protrusidens*: HABE, 1983, pp. 82–83.

*Nassarius (Zeuxis) protrusidens*: CERNOHORSKY, 1984, pp. 149–150, pl. 30, figs. 2–4.

*Materials examined.* 2 specimens, NSMT-Mo 70717 (St. CB-0).

*Remarks.* This species is distributed in Madagascar, Pakistan, China and Australia (CERNOHORSKY, 1984). In Japan, it was first recorded from a depth of 100m off Minabe, Kii Peninsula (HABE, 1984). This is the first record of this species from the Japan Sea.

#### Family Olividae LATREILLE, 1825

#### *Olivella spretoides* YOKOYAMA, 1922

(Pl. 2, Figs. 4a, 4b, 5)

[Japanese name: Watazoko-Botaru-Gai]

*Olivella spretoides* YOKOYAMA, 1922, p. 47, pl. 2, fig. 4.

*Materials examined.* 9 specimens, NSMT-Mo 70718 (St. HK-2).

*Remarks.* The type specimen of this species is fossil from Shito, Chiba Prefecture (YOKOYAMA, 1922). From the Japan Sea, living specimens of this species were collected from off Noto Peninsula (ITO, 1986) and Wakasa Bay (ITO, 1990).

## Family Turridae SWAINSON, 1840

*Cymatosylinx* sp.

(Pl. 3, Figs. 1a, 1b)

*Material examined.* 1 specimen, NSMT-Mo 70719 (St. HK-2).

The shell is slenderly fusiform ( $L/W=2.7$ ), thick, polished, and opaque white. The protoconch is globular and smooth, with about 2 whorls. Teleoconch whorls are 7 in number, with walls that slightly swelled in abapical  $1/3$  to  $1/4$ , separated by distinct and constricted sutures. Surface is ornamented by indistinct longitudinal ribs and fine growth lines. Both of them are strongly flexuous in the adapical  $1/3$ . Longitudinal ribs are low and indistinct, and obliquely set, about 15 in number on the body whorl. The periphery of the body whorl is convex. The base is smooth except of about 5 spiral lirae on the umbilical region. There is no umbilicus. The aperture is slenderly rhombic. The columella is thick. The inner wall is covered by thick callus continuous from the columellar fold. The outer lip is somewhat thick, with a distinct anal sinus.

*Remarks.* This species resembles the species reported as *Cymatosylinx* sp. from off Tsunoshima Island by SUGIMURA (1990) and *Cymatosylinx* (*C.*) *laevis* SHUTO, 1965. More reliable identification of this species needs examination of the type materials of the allied related species.

*Gemmula* (*Gemmula*) *pseudogranosa* (NOMURA, 1940)

(Pl. 3, Figs. 2a, 2b)

[Japanese name: Nishiki-Juzukake-Kudamaki-Gai]

*Turris* (*Gemmula*) *pseudogranosa* NOMURA, 1940, p. 112, pl. 2, figs. 2a, 2b.*Gemmula* (*Gemmula*) *pseudogranosa*: KURODA *et al.*, 1971, pp. 343–344 (Jap.), 211 (Eng.), pl. 57, fig. 10.*Material examined.* 1 specimen, NSMT-Mo 70720 (St. HK-2).

*Remarks.* This species has been known from the south to Choshi, and Pacific coast of Shikoku (KURODA *et al.*, 1971). This is the first record of this species from the Japan Sea.

*Hemilienardia* sp.

(Pl. 2, Figs. 13a, 13b)

*Material examined.* 1 specimen, NSMT-Mo 70721 (St. CB-0).

The shell is rhombic oval ( $L/W=2.0$ ), thick, and pale pinkish yellow. The protoconch has 3 whorls, with many minute dots which become irregularly reticulated sculpture abapically. Teleoconch whorls are 7 in number, with convex walls that angulated adapically, separated by distinct and constricted sutures.

Surface is ornamented by thick and rounded longitudinal ribs. The number of longitudinal ribs is 12 on the body whorl. Interspaces of longitudinal ribs are nearly as wide as ribs. Spiral ridges cross both longitudinal ribs and their interspaces, creating nodules especially on longitudinal ribs. The number of spiral ridges are 2 on the first and second whorls, 3 on the fourth whorl, 5 on the body whorl excluding basal part. Of these spiral ridges, the adapicalmost one of each whorl are feeble and indistinct, while the others are strong and well-developed. The width of interspaces of these ridges are nearly equal to those of ridges on the adapical part of each whorl, while those on the middle to abapical part they are about thrice as wide as ridges. The periphery of the body whorl is convex. The base excluding the siphon is ornamented by the longitudinal ribs continueing from the adapical part of the body whorl with 3 distinct spiral ridges. Interspaces of these ridges are about thrice as wide as the ridges. The siphon is slightly protrudes anteriorly, with about 10 indistinct and narrow spiral ridges, of which interspaces are nearly equal to ridges in width. The aperture is rectangular. The columella and inner lip are covered by very thin callus. The outer lip is thick, with 4 conspicuous teeth inside. The ourter side of the margin of the outer lip is crenulated due to 8 nodulations of the outer sculpture. The adapicalmost part of the outer lip forms a distinct anal sinus.

*Remarks.* Although this species resembles *Hemilienardia thylidota* (MELVILL et STANDEN, 1901), it differs from the latter in having rougher and sharper sculpture. However, since the present specimen may be an infra-specific variation of *H. thylidota*, final identification needs further investigation on many individuals. This species was once recorded from Wakasa Bay, the Japan Sea (ITO, 1990).

### *Cytharopsis radulina* KURODA et OYAMA, 1971

(Pl. 3, Figs. 3a, 3b)

[Japanese name: Yasuri-Kototsubu]

*Cytharopsis radulina* KURODA et OYAMA, 1971, pp. 355–356 (Jap.), 227–228 (Eng.), pl. 55, fig. 13, pl. 111, fig. 13.

*Material examined.* 1 specimen, NSMT-Mo 70722 (St. HK-2).

*Remarks.* This species is distributed on the Pacific coast of Honshu (KURODA *et al.*, 1971). In the Japan Sea, ITO (1989) first reported this species from off Niigata.

### *Daphnella* sp.

(Pl. 3, Figs. 4a, 4b, 5, 6)

*Materials examined.* 5 specimens, NSMT-Mo 70723 (St. HK-2).

The shell is oblong ovate (L/W=2.3-2.4), somewhat thin, opaque milky

white to pale yellow. The protoconch has 2 whorls with fine textured sculpture. Teleoconch whorls are 6 in number, separated by distinct and constricted sutures. The walls of the adapical to middle whorls are slightly convex with weak shoulder, while those of the abapical whorls are gently convex. Surface is ornamented by oblique and rough longitudinal ribs and dense spiral lirae. Although ribs are barely visible on the adapical whorls, they become indistinct or almost vanishing on the abapical whorls. Spiral lirae are indistinct, about 25 in number on the body whorl excluding the base. The periphery of the body whorl is gently convex. The siphon slightly protrudes anteriorly. The base of the body whorl including on the siphon present 30 to 40 spiral lirae, which are slightly more distinct than those on the adapical part of the whorl. The aperture is ovo-rhombic. The columella and inner lip are covered by very thin and indistinct callus. The outer lip is thin, forming a wide anal sinus at its adapicalmost part.

*Remarks.* This species closely resembles the one illustrated by Oyama [1958, pl. *Daphnella* (2), figs. 7, 8, as *Daphnella angulata* Kuroda, MS.], but differ from the latter in having longer body whorl, gently convex whorls, and obsolete sculpture. Final identification of this species needs examination of the other related species in the Indo-Pacific.

Subclass HETEROBRANCHIA GRAY, 1840

Order HETEROSTROPHA FISCHER, 1885

Family Pyramidellidae GRAY, 1840

*Odostomia tenera* A. ADAMS, 1860c

(Pl. 4, Fig. 3)

[Japanese name: Sukashi-Kuchikire-Gai-Modoki]

*Odostomia tenera* A. ADAMS, 1860c, p. 21.

*Odostomia* (*Marginodostomia*) *tenera*: KURODA *et al.*, 1971, p. 444 (Jap.), p. 277 (Eng.), pl. 114, fig. 7.

*Odostomia* (*Odostomia*) sp. (No. 6): ITO, 1990, p. 107, pl. 20, figs. 6, 12, 13.

*Materials examined.* 8 specimens (St. CB-2); 10 specimen (St. HK-2); 3 specimen, NSMT-Mo 70724 (St. HK-3); 4 specimen (St. HK-4); 100 specimen (St. HK-5).

*Remarks.* This species is similar to *O. (M.) subangulata* A. ADAMS, 1860, but differs from the latter in having wider shell appearance and presence of the internal lirae on the inner side of the outer lip. This species was at first collected off Mishima Island (A. ADAMS, 1860c). Later, this species occurred in various regions of Honshu and Kyushu (KURODA *et al.*, 1971; ITO, 1990).



*Chrysallida rufolineata* A. ADAMS, 1863a

(Pl. 4, Fig. 4)

[Japanese name: Mikoto-Kuchikire-Gai]

*Chrysallida rufolineata* A. ADAMS, 1863a, p. 3.*Herviera* sp. (No. 1): ITO, 1990, p. 109, pl. 23, fig. 8.*Chrysallida* (*Herviera*) *rufolineata*: TSUCHIDA *et al.*, 1993, pp. 12–13, fig. 4.

**Materials examined.** 1 specimen, NSMT-Mo 70725 (St. HK-3); 2 specimens (St. HK-5).

The shell is tall, oval ( $L/W = 2.7$ ), polished, and milky white. A narrow, pale reddish brown band is present at slightly above the middle of each whorl and basal margin of the body whorl. The protoconch is helicoid with 2 whorls, in  $135^\circ$  heterostrophy, smooth, and about  $1/2$  of it is obliquely immersed in the first teleoconch whorl. Teleoconch whorls are 6 in number, separated by distinct and subconstricted sutures. The walls of the teleoconch are nearly straight but slightly constricted at the middle. Outer surface is ornamented by nearly straight longitudinal ribs, 17 in number on the body whorl. Interspaces of longitudinal ribs are smooth, as wide as the ribs, deeply constricted at upper  $1/3$  to  $1/4$ . The periphery of the body whorl is rounded, where longitudinal ribs weaken. The base of the body whorl has rudimentary longitudinal ribs, which vanish gradually toward the umbilical region. There is no umbilicus. The aperture is ovo-rhombic. The columella is somewhat straight, with a strong oblique columellar fold at its adapical part. A continuous thick callus covers the columella, the inner wall, and the outer lip. The inner side of the outer lip is smooth.

**Remarks.** This species had not been illustrated in the original description (A. ADAMS, 1863a). However, the present specimens well accord with the context of the original description, such as, the shape of the shell, condition of color band, the shape of the walls of the teleoconch, longitudinal ribs, interspaces of the ribs, aperture, and columellar fold. *C. patriola* (PILSBRY, 1917) and *C. opaca* (HEDLEY, 1905) are similar to this species, but they possess 3 bands on their body whorl. *C. chorea* (HEDLEY, 1909) and *C. fasciata* (LASERON, 1959) have larger body whorl and less constricted suture compared with those of this species. The type locality of this species is off Goto Islands, Nagasaki (A. ADAMS, 1863a). Later, it occurred in Wakasa Bay (ITO, 1990) and Zenisu, in the Izu Islands (TSUCHIDA *et al.*, 1993).

*Chrysallida plicata* A. ADAMS, 1860b

(Pl. 4, Fig. 5)

[Japanese name: Kinuji-Kuchikire-Gai]

*Chrysallida plicata* A. ADAMS, 1860b, p. 478.

*Chrysallida (Salassia) plicata*: ITO, 1990, p. 108, pl. 22, fig. 2.

**Materials examined.** 4 specimens (St. HK-3); 2 specimens, NSMT-Mo 70726 (St. HK-5).

The shell is oblong ovo-conic ( $L/W=2.2$ ), somewhat thick, slightly polished, and milky white. The protoconch is helicoid, in  $180^\circ$  heterostrophy, smooth, and about  $1/3$  of it is immersed in the first whorl of teleoconch. Teleoconch whorls are 5 in number, and separated by distinct and deep sutures. The walls of the teleoconch are nearly straight but obsoletely angulated at abapical  $1/3$  part. Surface is ornamented by distinct longitudinal ribs which are nearly straight or slightly oblique, 23 in number on the body whorl. Interspaces of longitudinal ribs are slightly wider or about twice as wide as ribs, sculptured by many indistinct microscopic spiral lirae. In addition, a single distinct and narrow spiral ridge is present at abapical  $1/3$  part in interspaces of each whorl. The periphery of the body whorl is convex. The base of the body whorl possesses the longitudinal ribs continuous from the body whorl, which becomes obsolete toward the umbilical region. Interspaces of ribs on the base have distinct and fine spiral lirae, 13 in number. There is narrow umbilicus. The columella is somewhat thick and concave, possesses a distinct transverse columellar fold at its adapical part. The inner wall is covered by very thin callus. Aperture is oval. The outer lip is more or less thin with about 6 internal lirae on its inner side.

**Remarks.** The present specimens well agree with the drawing and description by the late Dr. J. MAKIYAMA of the type specimen. The type locality of this species is off Mishima Island. Later, it occurred in Goto Islands (A. ADAMS, 1863 a), Kii-Oshima (A. ADAMS, 1863a), and Wakasa Bay (ITO, 1990). This is the first re-discovery of this species from the type locality. The specimen figured by INABA (1982) from Bingo, Seto Inland Sea, is not identical with this species.

### *Chrysallida pulchella* A. ADAMS, 1860b

(Pl. 4, Fig. 6)

[New Japanese name: Otogi-Kuchikire-Gai]

*Chrysallida pulchella* A. ADAMS, 1860b, p. 479.

*Chrysallida (Salassia) pulchella*: ITO, 1990, p. 108, pl. 22, fig. 4.

**Materials examined.** 2 specimens (St. HK-2); 13 specimens, NSMT-Mo 70727 (St. HK-3); 27 specimens (St. HK-5).

The shell is oval ( $L/W=2.0$ ), somewhat thick, slightly polished, and milky white. The protoconch is helicoid, in  $180^\circ$  heterostrophy, smooth, about  $1/3$  of it is immersed in the first teleoconch whorl. Teleoconch whorls are 4 in number, separated by distinct and deep sutures. The walls of the teleoconch are somewhat convex, with acute shoulder. Surface is ornamented by longitudinal and nearly

straight ribs reaching to 21 in number on the body whorl. Interspaces of longitudinal ribs are about twice as wide as ribs, sculptured by distinct and fine spiral lirae, 10 above the convex periphery. The base of the body whorl is sculptured by longitudinal ribs and the spiral lirae continuous from the the body whorl. Longitudinal ribs become feebler toward the umbilical region, where present only spiral lirae. There is a distinct and somewhat wide umbilicus. The columella is thin and oncave, possessing an oblique and weak columellar fold at its adapical part. The aperture is oval. The inner wall is covered by thin callus. The outer lip is somewhat thin and simple, smooth inside.

*Remarks.* The present specimens well agree with the drawing and description by the late Dr. J. MAKIYAMA of the type specimen. The type locality of this species is off Mishima Island. Later, this species occurred in Goto Islands, Nagasaki (A. ADAMS, 1863a), Seto Inland Sea including Akashi (A. ADAMS, 1863a), Wakasa Bay (ITO, 1990), Tateyama Bay (HORI, pers. obs.), and Otsuchi Bay (HORI, pers. obs.). This is the first re-discovery of this species from the type locality. This species may distribute widely on the Pacific coast and the Japan Sea coast.

*Chrysallida punctigera* (A. ADAMS, 1860d)

(Pl. 4, Fig. 7)

[New Japanese name: Ayatori-Kuchikire-Gai]

*Parthenia punctigera* A. ADAMS, 1860d, p. 415.

*Chrysallida* (*Besta*) sp.: ITO, 1990, p. 109, pl. 23, fig. 1.

*Materials examined.* 56 specimens, NSMT-Mo 70728 (St. HK-3).

The shell is ovo-conic ( $L/W=2.2$ ), thick, slightly polished, and milky white. The protoconch is helicoid, in  $180^\circ$  heterostrophy, smooth, and about  $1/3$  of it is immersed in the first whorl of teleoconch. Teleoconch whorls are 5 in number, separated by distinct and deep sutures. Walls of whorls are slightly convex, feebly angulated abapically. Surface is ornamented by distinct longitudinal ribs which are slightly oblique or somewhat flexuous, 20 in number on the body whorl. Interspaces of longitudinal ribs are as wide as or slightly wider than ribs, possessing 5 narrow spiral ridges, of which, the abapical 3 are very strong and distinct, while the others are very feeble. The periphery of the body whorl is round. The base of the body whorl is ornamented by spiral ridges and longitudinal ribs continuous from the body whorl. Longitudinal ribs become obsolete toward the umbilical region. Spiral ridges are as strong as longitudinal ribs, and 6 in number including the one on the periphery. There is a distinct and somewhat wide umbilicus. The columella is thin, concave, and possesses a tiny columellar fold. A continuous thin callus covers the columella, inner wall, and outer lip. The aperture is oval. The outer lip is thin, and smooth within.

**Remarks.** The present specimens well agree with the drawing and description by the late J. MAKIYAMA of the type specimen. Some specimens have nearly straight longitudinal ribs and more angulated periphery. The type locality of this species is Sado Island (A. ADAMS, 1860d). Later, ITO (1990) collected this species from Wakasa Bay.

***Chrysallida mariella* (A. ADAMS, 1860d)**

(Pl. 4, Fig. 8)

[New Japanese name: Tatsumaki-Kuchikire-Gai]

*Parthenia mariella* A. ADAMS, 1860d, p. 415.

*Odostomia (Egilina) mariella*: DALL and BARTSCH, 1906, Proc. U. S. Nat. Hist. Mus. 30, p. 354, pl. 22, fig. 4.

*Egilina mariella*: INABA, 1963, p. 123, pl. 3, fig. 4.

**Materials examined.** 2 specimens (St. HK-2); 4 specimens, NSMT-Mo 70729 (St. HK-3).

**Remarks.** This species resembles *C. mariellaeformis* NOMURA, 1938, but it is distinguished from the latter in having shorter conical shell and more spiral keels on the base of the body whorl. The type locality of this species is off Mishima Island. This species occurred in Goto Islands (A. ADAMS, 1863a), Tsushima (A. ADAMS, 1863a), Seto Inland Sea (A. ADAMS, 1863a; INABA, 1963; HORI, pers. obs.), Nagato, Yamaguchi Prefecture (HORI, pers. obs.), and Amami-Oshima Island (HORI, pers. obs.), showing a wide distributions in Japan. This is the first re-discovery of this species from the type locality.

***Eulimella diaphana* (A. ADAMS, 1861a)**

(Pl. 4, Figs. 9a, 9b)

[New Japanese name: Erimaki-Setomono-Kuchikire-Gai]

*Ebala diaphana* A. ADAMS, 1861a, p. 43.

**Materials examined.** 1 specimen (St. HK-3); 1 specimen, NSMT-Mo 70730 (St. CB-2).

The shell is tall conic ( $L/W=2.7$ ), thick, polished, and translucent white. The protoconch is heliocoid, in  $120^\circ$  heterostrophy with 2 smooth whorls and about  $1/3$  of it is obliquely immersed in the first whorl of teleoconch. Teleoconch whorls are 5 in number, with walls that swell especially abapically, and separated by distinct and constricted sutures. Surface is ornamented by feebly flexuous growth lines. Since whorls are abruptly and distinctly constricted in adapical  $1/4$  to  $1/5$  part, each whorl is apparently encircled by a distinct subsutural band. The periphery of the body whorl is round. The columella is thick and slightly concave, bearing no columellar fold. There is no umbilicus. The aperture is ovo-quadrate.

The inner wall is not covered by callus. The outer lip is smooth within.

*Remarks.* This species was not illustrated in the original description (A. ADAMS, 1861a). But, the present specimens well match with the context of the original description, such as rounded whorl and marginated suture. The type locality of this species is "Port Hamilton". This is the first re-discovery of this species and also first record from Japan.

*Tropaeas strigulata* (A. ADAMS, 1863c)

(Pl. 4, Fig. 10)

[Japanese name: Kokizami-Hida-Kuchikire-Gai]

*Elusa strigulata* A. ADAMS, 1863c, p. 237.

*Materials examined.* 2 specimens, NSMT-Mo 70731 (St. HK-3).

The shell is tall conic ( $L/W = 1.7$ ), somewhat thin, polished, and milky white. A narrow pale orange band runs on the periphery. The protoconch is smooth, helicoid with 2 whorls, in  $90^\circ$  heterostrophy, and about  $1/3$  of it is immersed in the first teleoconch whorl. Teleoconch whorls are 9 in number, with nearly straight but slightly convex walls, and separated by distinct and slightly constricted sutures. Surface is ornamented by numerous microscopic spiral lirae and narrow longitudinal grooves, which are nearly straight, narrower than those interspaces, sculptured by microscopic spiral lirae, and are strong in adapical part of each whorl but becomes weaker and denser abapically. The number of longitudinal grooves is 40 on the body whorl. The periphery of the body whorl is round. The base is sculptured by longitudinal grooves continuous from the body whorl, which become weaker toward the umbilical region. There is no umbilicus. The aperture is ovo-rhombic. The columella is feebly curved, presenting a weak columellar fold in the adapical part. The inner wall is covered by a very thin and translucent callus. The outer lip is thin, and smooth within.

*Remarks.* The present specimens well agree with the drawing and description by the late Dr. J. MAKIYAMA of the type specimen of this species. This species is easily distinguished from the other similar looking species by somewhat thin shell, pale orange band on the periphery of the whorls, narrow longitudinal grooves which are sculptured by microscopic spiral lirae, and a single columellar fold. The type locality of this species is Yobuko, northern Kyushu. Later, this species has been found in Shima Peninsula, Mie Prefecture and Genkai-Nada, Northern Kyushu (HIGO & GOTO, 1993).

*Turbonilla elegantula* (A. ADAMS, 1860b)

(Pl. 4, Fig. 11)

[New Japanese name: Yuuga-Itokakegiri-Gai]

*Chrysallida elegantula* A. ADAMS, 1860b, p. 478.*Turbonilla* (*Turbonilla*) *elegantula*: ITO, 1990, p. 109, pl. 23, fig. 13.

**Materials examined.** 5 specimens, NSMT-Mo 70732 (St. HK-3); 3 specimens (St. HK-5).

The shell is tall conic ( $L/W=3.2$ ), somewhat thin, slightly polished, and opaque white. The protoconch is helicoid with 2 smooth whorls, in  $100^\circ$  heterostrophy, and about  $1/3$  of it is obliquely immersed in the first whorl of teleoconch. Teleoconch whorls are 7 in number, with acute shoulder and slightly convex abapically, separated by distinct and constricted sutures. Surface is ornamented by nearly straight longitudinal ribs reaching 25 in number on the body whorl, that carry small nodules on the shoulder. Interspaces of longitudinal ribs are smooth, as wide as the ribs in abapical whorls, but slightly wider than those in adapical whorls. The periphery of the body whorl is round. Longitudinal ribs terminate at the basal periphery. The base is smooth. There is no umbilicus. The columella is thin, obliquely straight, with no columellar fold. The aperture is ovo-rhombic. The inner wall is covered by a very thin callus. The outer lip is thin, and smooth within.

**Remarks.** The present specimens well agree with the drawing and description by the late Dr. J. MAKIYAMA of the type specimen of this species. Although this species resembles *T. ambulatia* (LASERON, 1959), it differs from the latter in having large number of longitudinal ribs and narrower interspaces. The type locality of this species is off Mishima Island (A. ADAMS, 1860b). This species subsequently occurred in Wakasa Bay (ITO, 1990), Hibiki-Nada (HORI, pers. obs.), western Seto Inland Sea (HORI, pers. obs.). This species may be distributed widely in western Japan. This is the first re-discovery of this species from the type locality.

*Turbonilla matunamiensis* OTUKA, 1935

(Pl. 4, Fig. 12)

[New Japanese name: Koushibari-Itokakegiri-Gai]

*Turbonilla* (*Pyrgiscus*) *matunamiensis* OTUKA, 1935, pp. 864-865, fig. 224.

**Materials examined.** 1 specimen (St. HK-2); 11 specimens, NSMT-Mo 70733 (St. HK-3); 2 specimens (St. CB-2).

The shell is tall conic ( $L/W=3.8$ ), thick, polished, and opaque white. The protoconch is helicoid, smooth, in  $135^\circ$  heterostrophy, smooth, and about  $1/3$  of

it is obliquely immersed in the first whorl of teleoconch. Teleoconch whorls are 7 in number, with slightly convex walls, separated by distinct and constricted sutures. Surface is ornamented by longitudinal ribs which are oblique and slightly flexuous. The number of the ribs are 20 on the body whorl. Interspaces of ribs are nearly equal to ribs in width on the abapical whorls. The abapical half of whorls is present 2 distinct and narrow spiral ridges. The periphery of the body whorl is convex, where longitudinal ribs abruptly terminate. The base has a few narrow spiral grooves. There is no umbilicus. The columella is somewhat thick and slightly concave, with a tiny columellar fold at adapical part. The inner lip is covered by a thin callus. The aperture is ovo-quadrangle. The outer lip is more of less thin, smooth within.

*Remarks.* This species can be easily distinguished from the other species by 2 distinct spiral ridges in interspaces of longitudinal ribs on the abapical half of whorls and a few spiral groove on the base. The type locality of this species is Miyainu, Noto Peninsula (Pleistocene) (OTUKA, 1935). This is the first re-discovery of this species.

*Turbonilla speciosa* A. ADAMS, 1860d

(Pl. 4, Figs. 13a, 13b)

[New Japanese name: Garasuzai-Itokakegiri-Gai]

*Turbonilla speciosa* A. ADAMS, 1860d, p. 420.

*Materials examined.* 4 specimens, NSMT-Mo 70734 (St. HK-4); 2 specimens (St. CB-2).

The shell is tall conic ( $L/W=4.3$ ), thick, polished, and translucently snow white. The protoconch with 2 smooth whorls is in about  $90^\circ$  heterostrophy, and about  $1/4$  of it is immersed in the first whorl of teleoconch. Teleoconch whorls are 10 in number, with more or less convex walls, separated by distinct and constricted sutures. Surface is ornamented by longitudinal ribs. Ribs are slightly bent or flexuous, which abruptly terminate at the basal periphery, 16 in number on the body whorl. On the body whorl some of ribs fuse to each other creating thick varices. Interspaces of longitudinal ribs are about twice as wide as ribs, sculptured by about 10 obsolete spiral lirae, of which abapical 4 to 5 are more distinct than the adapical ones. The periphery of the body whorl is convex. The base of the body whorl is ornamented by feeble longitudinal ribs and about 10 obsolete spiral lirae. There is no umbilicus. The columella is straight with no columellar fold. The inner lip is covered by a very thin callus. The aperture is ovo-quadrangle. The inner lip is thin, smooth within.

*Remarks.* The present specimens well agree with the drawing and description by the late Dr. J. MAKIYAMA of the type specimen. The type locality of this species is off Mishima Island (A. ADAMS, 1860d). This is the first re-discovery of

this species.

Order BULLOMORPHA PELSENEER, 1906

Family Acteonidae d'ORBIGNY, 1835

*Acteon kawamurai* HABE, 1952

(Pl. 3, Fig. 7)

[Japanese name: Kawamura-Kijibiki-Gai]

*Acteon kawamurai* HABE, 1952, pp. 70, 76, textfig. 1; Habe, 1954, p. 303, pl. 38, fig. 5.

**Materials examined.** 5 specimens, NSMT-Mo 70735 (St. HK-3); 2 specimens (St. HK-5).

The shell is oblong oval ( $L/W=1.8$ ), somewhat thick, slightly polished, and opaque dirty white. The protoconch is lost. Teleoconch whorls are 5 in number, with slightly convex walls, separated by distinct and constricted sutures. Surface is ornamented by indistinct growth lines and many strong and narrow spiral keels that are nearly equal in size, 4 on the third whorl, 7 on fourth whorl, and 26 on the body whorl including those on the base. Interspaces of the spiral keels are as wide as or slightly wider than keels, sculptured by distinct and fine longitudinal lirae. The intersections of spiral keels and longitudinal lirae are feebly granulated. The umbilicus is wide and distinct. The columella is thick and obliquely straight, with a strong and oblique columellar fold at its adapical  $1/3$ . The inner wall is covered by a thin callus. The outer lip is thick, crenulated because of extremities of spiral keels.

**Remarks.** The type locality of this species is Sagami Bay (HABE, 1952). This is the first record of this species from the Japan Sea.

Family Cylichnidae H. and A. ADAMS, 1854

*Cylichna (Adamnestia) rimata* A. ADAMS, 1862a

(Pl. 5, Fig. 1)

[Japanese name: Tosa-Kudatama-Gai]

*Cylichna rimata* A. ADAMS, 1862a, p. 151.

*Adamnestia tosaensis* HABE, 1854, p. 309, pl. 38, figs. 11, 12; KURODA *et al.*, 1971, pp. 469 (Jap.), 295 (Eng.), pl. 115, fig. 12.

**Materials examined.** 1 specimen (St. CB-1); 2 specimens, NSMT-Mo 70736 (St. CB-2); 1 specimen (St. HK-3); 10 specimens (St. HK-4).

The shell is slightly ventricose ovo-cylindrical ( $L/W=2.5$ ), thin, slightly polished, and opaque white. The vertex presents the apical hole which is a little over  $1/4$  of the diameter of the shell. The margin of the vertex is rounded. Total



surface is ornamented by indistinct growth lines and numerous microscopic spiral grooves. The areas around the anterior and posterior ends present distinct spiral grooves. Grooves on the anterior area are 15 in number, located between anterior about  $2/5$  of the shell to the umbilical margin, and interspaces of these grooves become narrower adapically and abapically. While, those on the posterior area are 12 in number, situated between around apical hole and posterior  $1/5$  part of the shell, and interspace become narrower adapically. The columella is thin, oblique, straight with no columellar fold. The columella and the anterior part of the inner lip are covered by a slight callus. The umbilicus is distinct and very wide. The anterior part of the aperture protrudes anteriorly terminating in the acute anterior end. The outer lip is thin with gently convex basal margin and its posterior round margin protrudes posteriorly.

*Remarks.* This species was not illustrated in the original description (A. ADAMS, 1862a). But, the present specimens well agree with the context of the original description, such as, opened apical hole, spiral grooves on the anterior and posterior parts of the shell, widely opened umbilicus, the anteriorly protruded aperture, and acute anterior end, and the adapically and roundly protruded posterior margin of the outer lip. The type locality of this species is Korea Straits (A. ADAMS, 1862a). HABE (1954) once collected this species from Yuya Bay, Yamaguchi Prefecture (as *Adamnestia tosaensis*). This species is distributed widely Kyushu, Shikoku, and Honshu (HABE, 1954).

*Cylichna (Adamnestia) consobrinoides* KURODA et HABE, 1952

(Pl. 5, Fig. 2)

[New Japanese name: Kiba-Kudatama-Gai]

*Cylichna consobrina* A. ADAMS, 1862a. p. 152 (non GOULD 1859).

*Cylichna consobrinoides* KURODA et HABE, 1952, p. 50.

*Materials examined.* 2 specimens, NSMT-Mo 70737 (St. CB-2); 1 specimen (St. HK-4).

The shell is ovo-cylindrical but swelled at its middle to anteriorly ( $L/W = 2.5$ ), thick, slightly polished, and opaque white. The vertex has the apical hole which is a little over  $1/4$  of the diameter of the shell. The margin of the vertex is rounded. Total surface is ornamented by indistinct growth lines and numerous microscopic spiral lirae. Areas around the anterior and posterior ends present distinct spiral grooves. Grooves on the anterior area are 25 in number, located in the anterior about  $2/5$  of the shell to the umbilical margin, and interspaces of the grooves become wider toward the umbilical region. While those on the posterior area are 12 in number, situated around the apical hole to posterior about  $1/6$  of the shell, interspaces become narrower toward the apical hole. The columella is thick, obliquely set, with a low projection at its anterior part. The columella and the

inner lip are covered by a thick callus. The umbilicus is distinct and somewhat narrow. The outer lip is thick. The basal margin is convex. The posterior margin of the outer lip protrudes posteriorly and round, and it is connected with the callus of the inner lip.

*Remarks.* This species was not illustrated in the original description (A. ADAMS, 1862a). But, the present specimens well agree with the context of the original description, such as, spiral grooves on the anterior and posterior parts of the shell, strong projection on the anterior part of the columella, thicker shell and lack of the conspicuous umbilical fissure in comparison with *C. rimata*. The type locality of this species is off Mishima Island (A. ADAMS, 1862a). This is the first re-discovery of this species.

*Cylichna (Adamnestia) crispula* WATSON, 1886

(Pl. 5, Fig. 3)

[Japanese name: Kinudutsumi-Kudatama-Gai]

*Cylichna crispula* WATSON, 1886, p. 666, pl. 49, fig. 12; Pilsbry, 1893, pp. 315–316, pl. 30, fig. 12.

*Cylichna (Adamnestia) crispula*: HORI and TSUCHIDA, 1994, p. 12, pl. 1, fig. 2.

*Materials examined.* 6 specimens, NSMT-Mo 70738 (St. HK-2).

The shell is oblong ovate ( $L/W=2.0$ ), thin, and translucent snow white. The vertex tapers presenting a tiny apical hole. The surrounding of the vertex is convex. Surface is ornamented by indistinct microscopic growth lines and indistinct spiral lirae, which become stronger abapically. There is no umbilicus. The columella is wide and thick, and possesses a low projection in the middle. The inner lip is not covered by a callus. The outer lip is thin. The basal lip is convex, while the posterior margin is round and protrudes posteriorly.

*Remarks.* Some individuals possess a closed apical hole and the inner lip covered by a thin callus. The strength of the columellar projection varies by individual. The type locality of this species is Raine Island, Cape York, Australia (WATSON, 1886). HORI and TSUCHIDA (1994) first recorded this species from Japan and re-described in Japanese and illustrated the present specimen.

*Cylichna (Eocylichna) inedita* A. ADAMS, 1862a

(Pl. 5, Fig. 4)

[Japanese name: Yuki-Kudatama-Gai]

*Cylichna inedita* A. ADAMS, 1862a, p. 153.

*Cylichna (Eocylichna) inedita*: HORI and TSUCHIDA, 1994, p. 11.

*Materials examined.* 1 specimen, NSMT-Mo 70739 (St. CB-0); 11 specimens (St. HK-2); 2 specimens (St. HK-3); 2 specimens (St. HK-4); 1 specimen

(St. HK-5).

The shell is ovo-cylindrical ( $L/W=2.7$ ), with nearly straight lateral sides, thick, polished, and translucent snow white. The vertex possesses an apical hole, which is a little over  $1/4$  of the diameter of the shell. The margin of the vertex is acutely angulated. Surface is ornamented by coarse growth lines which apparently become longitudinal grooves, which are strong on the posterior and middle parts but become indistinct anteriorly. There is no spiral sculpture. The columella is wide and thick, slightly concave. The abapical columella is involute inside creating a distinct columellar fold. The columella and the inner lip are covered by a thin continuous callus. Aperture produces anteriorly. The outer lip is thin. The basal lip is convex, while the posterior margin protrudes posteriorly creating an angle at its distal end.

**Remarks.** This species was not illustrated in the original description (A. ADAMS, 1862a). But, the present specimens are identified by the context of the original description, such as longitudinal grooves or coarse growth lines, anteriorly produced aperture, and conspicuous columellar fold. Although *C. toyamaensis* HABE, 1955 is similar to this species, it has no apical hole in contrast to this species. The type locality of this species is off Mishima Island (A. ADAMS, 1862a). HORI and TSUCHIDA (1994) once re-described in Japanese and illustrated the present specimen.

***Cylichna (Eocylichna) venustula* A. ADAMS, 1862a**

(Pl. 5, Figs. 5, 6, 7)

[Japanese name: Soyo-Kudatama-Gai]

*Cylichna venustula* A. ADAMS, 1862a, p. 151.

*Eocylichna soyoae* HABE, 1954, p. 310, pl. 38, figs. 15, 16; KURODA *et al.*, 1971, p. 468 (Jap.), pp. 293–294 (Eng.) pl. 115, fig. 9.

*Cylichnatys angusta*: ITO *et al.*, 1986, p. 23, pl. 31, fig. 2.

**Materials examined.** 18 specimens, NSMT-Mo 70740 (St. HK-3); 74 specimens, NSMT-Mo 70741 (St. HK-5).

**Remarks.** This species can be easily distinguished from the other species by rather ventricose appearance of shell. The proportion of the shell varies by individuals. The type locality of this species is off Mishima Island (A. ADAMS, 1862a), where HABE (1954) had once reported this species. This species is distributed widely around Japan (HABE, 1954).

***Cylichna (Eocylichna) involuta* (A. ADAMS, 1850)**

(Pl. 5, Fig. 8)

[Japanese name: Misumaki-Kudatama-Gai]

*Bulla (Cylichna) involuta* A. ADAMS, 1850, p. 595, pl. 125, fig. 151.

*Cylichna involuta*: PILSBRY, 1893, p. 310, pl. 27, fig. 83.

*Adamnestia involuta*: KURODA and HABE, 1954, p. 11, pl. 2, figs. 9, 10.

**Materials examined.** 2 specimens (St. CB-0); 1 specimen, NSMT-Mo 70742 (St. CB-2); 15 specimens (St. HK-2); 7 specimens (St. HK-3).

The shell is cylindrical ( $L/W=2.6$ ), thin, polished, and translucent snow white. The vertex possesses the apical hole which is a little over about  $1/7$  of the diameter of the shell. The margin of the vertex is conspicuously angulated. Surface is ornamented by indistinct growth lines and about 70 spiral grooves. Although the spiral grooves are generally indistinct, they tend to be distinct anteriorly. The columella is thick and slightly concave. The abapical columella involutes inside creating a strong columellar fold. The columella and the inner lip are fully covered by a thin callus. The umbilicus is narrow and indistinct. The outer lip is thin. The basal lip is convex. The posterior margin is round and protrudes posteriorly, connected with callus of the inner lip.

**Remarks.** This species resembles *C. inedita*, but it differs from the latter in presence of the umbilicus and feebler growth lines. The type locality of this species is "China Seas" (A. ADAMS, 1850). In Japan this species is known from Hirado, northwestern Kyushu (HSBE, 1955; HIGO & GOTO, 1993). This is the second record of this species from Japan.

#### Family Philinidae GRAY, 1850

##### *Philine orca* GOSLINER, 1988

(Pl. 5, Figs. 9a, 9b)

[Japanese name: Mongara-Kisewata-Gai]

*Philine orca* GOSLINER, 1988, pp. 79–83, figs 1–3.

**Material examined.** 1 specimen, NSMT-Mo 70743 (St. HK-2).

The shell is oval ( $L/W=1.6$ ), thin, slightly polished, and translucently dirty white. Although teleoconch whorls are about 3 in number, only the body whorl is visible from lateral side. Spiral grooves become lines of microscopic circular dots, and narrower than interspaces. The columella is thin, gently curves, without columellar fold. The inner lip is covered by an extremely thin and indistinct callus. There is no umbilicus. The outer lip is thin. The basal lip is convex. The posterior margin is connected with the lateral side of the vertex without producing. The junction between the outer lip and the inner lip creates a narrow and shallow sinus.

**Remarks.** The animal bears conspicuous coloration of black patches (GOSLINER, 1988). The type locality of this species is Papua New Guinea (GOSLINER, 1988). Later, this species has been reported from Sado, Toyama Bay, Echizen, Shionomisaki, and Sagami Bay (all HIGO & GOTO, 1993). But, this is the first

known specimen from the present locality.

***Philine striolata* A. ADAMS, 1862a**

(Pl. 5, Figs. 10a, 10b)

[Japanese name: Temari-Kisewata-Gai]

*Philine striolata* A. ADAMS, 1862a, p. 161; HORI and TSUCHIDA, 1994, pp. 12–13, pl. 1, fig. 3.

**Materials examined.** 1 specimen, NSMT-Mo 70744 (St. HK-3); 1 specimen (St. HK-5).

The shell is ovate ( $L/W = 1.3$ ), thin, barely polished, and opaque dirty white. Although teleoconch whorls are 3 in number, only the body whorl is visible from the lateral side. Surface is ornamented by coarse growth lines, which are conspicuous and become longitudinal lirae on the dorsal side of the body whorl, and many narrow spiral grooves, which are simple and narrower than interspaces. The columella is thin, gently curved, of which abapical part involutes inside creating an obsolete columellar fold. The inner lip is widely covered by an extremely thin callus. There is no umbilicus. The outer lip is thin. The basal lip is convex. There is a slight constriction at about adapical  $1/3$  of the lateral margin. The posterior margin slightly produces roundly and posteriorly. The junction between the outer lip and the inner lip creates a narrow and deep sinus.

**Remarks.** This species was not illustrated in the original description (A. ADAMS, 1862a). However, the present specimens are identifiable with the context of the original description, such as small shell, longitudinal lirae, posteriorly produced round posterior margin, shell. It is closely similar to *P. pruinosa* (CLARK, 1827). However, spiral grooves of this species are finer than those of the latter (A. ADAMS, 1862a). Although this species resembles *P. kawamurai* (HABE, 1958) and *P. orca* GOSLINER, 1988, it differs from them in having nonpunctuated spiral grooves. The type locality of this species is off Tsushima Island, Northern Kyushu (A. ADAMS, 1862a). HORI and TSUCHIDA (1994) once re-described in Japanese and illustrated the present specimen.

Family Retusidae THIELE, 1931

***Rhizorus opalinus* (A. ADAMS, 1862a)**

(Pl. 5, Fig. 11)

[Japanese name: Oparu-Mamehi-Gai]

*Volvulella opalina* A. ADAMS, 1862a, p. 154.

*Rhizorus opalinus*: HORI and TSUCHIDA, 1994, p. 13, pl. 1, fig. 4.

**Materials examined.** 1 specimen (St. HK-2); 1 specimen, NSMT-Mo 70745 (St. HK-3).

The shell is oblong oval ( $L/W=2.0$ ), somewhat thin, slightly polished, and translucently snow white. The apex produces posteriorly forming an acute cone. Surface is ornamented by indistinct and microscopic growth lines and spiral lirae. The anterior part of the shell is sculptured by about 7 distinct spiral grooves of which interspaces are rather wide. The posterior part of the shell also has several spiral grooves, which are extremely obsolete. The columella is thick, of which middle part is gently bent toward the aperture. The umbilicus is narrow but distinct. The inner lip is covered by a thin callus. The aperture slightly produces anteriorly. The outer lip is thin. The basal lip is convex. The posterior margin is gently convex and connected with callus of the adapical part of the inner lip. The inside of the posterior distal part of the inner lip is thickening.

**Remarks.** This species was not illustrated in the original description. However, the present specimens agree with the context of the original description, such as translucent and polished shell, spiral grooves on the anterior part of the shell, upwardly produced apex, opened umbilicus, and curved columellar fold. This species can be easily distinguished from the other similar looking species by spiral grooves on the anterior part of the shell. The type locality of this species is off Mishima Island, (A. ADAMS, 1862a). HORI and TSUCHIDA (1994) once re-described in Japanese and illustrated the present specimen.

Class BIVALVIA LINNAEUS, 1758

Subclass PTERIOMORPHIA BEURLIN, 1944

Order ARCOIDA STOLICZKA, 1871

Family Glycymerididae NEWTON, 1922

*Cranulilimopsis oblonga* (A. ADAMS, 1860a)

(Pl. 3, Figs. 8a, 8b, 9)

[Japanese name: Namijiwa-Shirasuna-Gai]

*Limopsis oblonga* A. ADAMS, 1860a, p. 229.

*Limopsis crenata* A. ADAMS, 1863b, p. 230.

**Materials examined.** 20 specimens, NSMT-Mo 70746 (St. HK-2); 20 specimens (St. HK-3); 20 specimens (St. HK-4); 20 specimens (St. HK-5); 20 specimens (St. HK-6); 20 specimens (St. CB-2).

**Remarks.** This species was originally described from off Mishima Island (A. ADAMS, 1860a). This species inhabits at depths of 50 to 150m on the continental shelf. The individuals inhabiting deeper water are not identical with this species (TSUCHIDA & KUROZUMI, 1993).

## Family Veneridae RAFINESQUE, 1815

*Callanaitis hiraseana* KURODA, 1930

(Pl. 3, Figs. 10a, 10b, 10c)

[Japanese name: Yume-Hamaguri]

*Callanaitis hiraseana* KURODA, 1930, pp. 2–3, textfig. 1.

**Materials examined.** 1 living specimen (St. HK-3); 2 specimens (St. HK-4); 4 specimens, NSMT-Mo 70747 (St. CB-2).

**Remarks.** The type locality of this species is off Yakushima Island, Kagoshima Prefecture (KURODA, 1930). This species is distributed south to Kii Peninsula (KURODA, 1930) on the Pacific coast and adjacent waters of Okinawa (TSUCHIDA, unpubl.). This is the first record of this species from the Japan Sea.

*Dosinia (Phacosoma) abyssicolum* HABE, 1961

(Pl. 3, Figs. 11a, 11b)

[Japanese name: Fuka-Kagami-Gai]

*Dosinia (Phacosoma) abyssicolum* HABE, 1961, p. 132, pl. 59, fig. 15, app. p. 38; TSUCHIDA and KUROZUMI, 1996, pp. 5–6, pl. 2, fig. 2.

**Material examined.** 1 specimen (St. HK-6).

**Remarks.** The type locality of this species was designated as depth of 143 m off Yamaguchi Prefecture (HABE, 1961), but actually it is located in the Tsushima Straits. Thus, this is the first record of this species from continental shelf off Yamaguchi Prefecture. *Dosinia (Phacosoma)* sp. from Otsuchi Bay, Iwate Prefecture (CBM-ZM 113949) is closely similar to this species, but it differs from the latter in having more compressed and thin shell in grayish brown color, finer growth lines which are not squamose around dorsal edge of the shell, and thin pallial sinus directing more dorsally (TSUCHIDA & KUROZUMI, 1996). Thus this species is known only from off Yamaguchi Prefecture and the Tsushima Straits.

## Discussion

The molluscan fauna of intertidal to upper-sublittoral depth along the Japan Sea coast of Yamaguchi Prefecture contains many warm current elements consisting of subtropical species (e.g. FUKUDA *et al.*, 1992; SUGIMURA & HOSAKA, 1993). However, the fauna of lower-sublittoral to bathyal depths exceeding about 50 m in this area has never been reported up to this date. TSUCHIDA and HAYASHI (1994), in discussing the faunal characteristics of depths of 50–200 m off Cape Hinomisaki and Oki Straits, divided this depth zone into 3 strata, viz. less

than about 100 m under the influence of surface water, deeper than 150–200 m under the influence of the cold water peculiar to the Japan Sea, and between 150–200 m as a transition zone of the former two. They reported that the molluscan fauna in shallower than 150–200 m consists of a large number of subtemperate species distributed in Japanese and adjacent waters with only 3–4% of warm current species in common with subtropical seas. In the present materials from the depths of 66–124 m around Mishima and Tsunoshima islands, only 5 subtropical species were recognized: *Microstelma japonica* (A. ADAMS, 1860), *Rissoina* (*Phosinella*) *sculptilis* GARRETT, 1873, *Nassarius* (*Zeuxis*) *protrusidens* (MELVILL, 1918), *Cylichna* (*Adamnestia*) *crispula* WATSON, 1886, and *Philine orca* GOSLINER, 1988, while all the remainders are subtemperate species. This fact supports that the fauna of lower-sublittoral to bathyal depths around Mishima and Tsunoshima islands is mainly occupied by sub-temperate species as in that of Cape Hinomisaki and Oki Straits reported by TSUCHIDA and HAYASHI (1994).

Secondary, the present survey resulted in new records of *Eulimella diaphana* (A. ADAMS, 1861) from Japan and the following 10 species from the Japan Sea: *Calliostoma sakashitai* (SAKURAI, 1994), *Rissoina* (*Phosinella*) *sculptilis* GARRETT, 1873, *Dentiovula colobica* AZUMA et CATE, 1971, *Phenacovolva tayloriana* AZUMA et CATE, 1971, *Cirsotrema plexis* DALL, 1925, *Fragilopalia nebulodermata* AZUMA, 1972, *Nassarius* (*Zeuxis*) *protrusidens* (MELVILL, 1918), *Gemmula* (*Gemmula*) *pseudogranosa* (NOMURA, 1940), *Acteon kawamurai* HABE, 1952, *Callanaitis hiraseana* KURODA, 1930.

Another noteworthy findings of the present survey are re-discoveries of the species of A. ADAMS who described 183 species including 163 new species from Mishima Island during 1860–1865. Because the original descriptions of A. ADAMS are extremely simple and lack of illustrations and measurements, although almost of his species are quite minute to small in size, many species have never been re-collected and identified with cretainity. Only 73 species (40%) of them have barely been recognized based on context in the original descriptions, the remaining 110 were left to be as unknown (KURODA, 1948). Since the areas under the present study covers the continental shelf around Mishima Island approximating to the area surveyed by ADAMS, the following 8 species were first re-discovered as the topotypes, namely: *Lissostesta japonica* (A. ADAMS, 1861), *Scala fimbriata* A. ADAMS, 1861 (= *Elegantiscala fimbriatula* MASAHIITO, KURODA et HABE, 1971), *Chrysallida plicata* A. ADAMS, 1860, *C. pulchella* A. ADAMS, 1860, *Chrysallida mariella* (A. ADAMS, 1860), *Turbonilla elegantula* (A. ADAMS, 1860), *T. speciosa* A. ADAMS, 1860, *Cylichna consobrina* A. ADAMS, 1862 [= *Cylichna* (*Adamnestia*) *consobrinoides* KURODA et HABE, 1952]. Of these species, *Elegantiscala fimbriatula* MASAHIITO, KURODA et HABE, 1971, *Chrysallida plicata* A. ADAMS, 1860, *C. pulchella* A. ADAMS, 1860, *Chrysallida mariella* (A. ADAMS, 1860), and *Turbonilla elegantula* (A. ADAMS, 1860) had



already been correctly identified based on the specimen from the other area in Japan.

In spite of the intensive survey, about 100 Adams's species from Mishima Island are still remained unrecognized. The number of unidentified species of the Pyramidellidae collected by the present survey attains about 100, far beyond 61 pyramidellids described by ADAMS (1860–1865) from Mishima Island. Among these unidentified species possibly include some many ADAMS's species, identification of them badly needs future detailed investigation on ADAMS's type specimens.

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## Explanation of plates

## Plate 1

- 1a. *Anatoma lamellata* (A. ADAMS, 1862). St. HK-3. SL=1.7 mm, SW=1.5 mm, NSMT-Mo 70700; 1b. Protoconch of *Anatoma lamellata*. Scale bar=33  $\mu$ m; 2a-c. *Calliostoma sakashitai* (SAKURAI, 1994). St. HK-2. SL=11.9 mm, SW=9.7 mm, NSMT-Mo 70701; 3a-b. Protoconch of *Conradia clathrata* A. ADAMS, 1860. St. CB-2. Scale bar=31  $\mu$ m; 4a. *Brookula tanseimaruae* n. sp. St. HK-3. SL=1.3 mm, SW=1.3 mm, NSMT-Mo 70703; 4b. Protoconch of *Brookula tanseimaruae*. Scale bar=74  $\mu$ m; 5a-5b. *Microstelma japonica* (A. ADAMS, 1860). St. HK-2. SL=1.1 mm, SW=1.7 mm, NSMT-Mo 70705; 6a-b. *Rissoina (Phosinella) sculptilis* GARRETT, 1873. St. HK-2. SL=10.5 mm, NSMT-Mo 70706, SW=5.2 mm; 7a-b. *Rissoina (Phosinella) sculptilis*. St. CB-0. SL=10.5 mm, SW=5.0 mm, NSMT-Mo 70707.

## Plate 2

- 1a-b. *Nassarius (Zeuxis) protrusidens* (Melvill, 1918). St. CB-0. SL=10.8 mm, SW=5.8 mm, NSMT-Mo 70717; 2a-c. *Dentiovula colobica* AZUMA et CATE, 1971. St. CB-0. SL=6.8 mm, SW=3.3 mm, NSMT-Mo 70708; 3a-b. *Phenacovolva tayloriana* AZUMA et CATE, 1971. St. CB-0. SL=15.3 mm, SW=3.7 mm, NSMT-Mo 70709; 4a-b. *Olivella spretooides* Yokoyama, 1922. St. HK-2. SL=17.2 mm, SW=6.4 mm, NSMT-Mo 70718; 5. *Olivella spretooides*. St. HK-2. SL=12.8 mm, SW=4.9 mm, NSMT-Mo 70718; 6a-b. *Nodiscala mormulaeformis* MASAHIRO, KURODA et HABE, 1971. St. HK-2. SL=10.9 mm, SW=4.3 mm, NSMT-Mo 70710; 7a-b. *Cirsotrema plexis* DALL, 1925. St. CB-2. SL=11.8 mm, SW=5.5 mm, NSMT-Mo 70711; 8a-b. *Elegantiscala fimbriatula* MASAHIRO, KURODA et HABE, 1971. St. HK-2. SL=12.2 mm, SW=4.6 mm, NSMT-Mo 70712; 9a-b. *Amaea cf. lixa* (IREDALE, 1931). St. HK-4. SL=15.9 mm, SW=5.6 mm, NSMT-Mo 70713; 10a-b. *Fragilopalina nebulodermata* AZUMA, 1972. St. HK-2. SL=15.8 mm, SW=5.1 mm, NSMT-Mo 70714; 11. *Vicinisca liliputana* (A. ADAMS, 1861). St. HK-2. SL=10.0 mm, SW=6.8 mm, NSMT-Mo 70715; 12a-b. *Papyriscala* sp. St. HK-2. SL=9.9 mm, SW=4.8 mm, NSMT-Mo 70716; 13a-b. *Hemilienardia* sp. St. CB-0. SL=7.7 mm, SW=3.8 mm, NSMT-Mo 70721.

## Plate 3

- 1a-b. *Cymatosylinx* sp. St. HK-2. SL=10.7 mm, SW=4.0 mm, NSMT-Mo 70719; 2a-b. *Gemmula (Gemmula) pseudogranosa* (NOMURA, 1940). St. HK-2. SL=16.3 mm, SW=5.1 mm, NSMT-Mo 70720; 3a-b. *Cytharopsis radulina* KURODA et OYAMA, 1971. St. HK-2. SL=17.8 mm, SW=6.3 mm, NSMT-Mo 70722; 4a-b. *Daphnella* sp. St. HK-2. SL=13.7 mm, SW=5.8 mm, NSMT-Mo 70723; 5. *Daphnella* sp. St. HK-2. SL=16.2 mm, SW=7.2 mm, NSMT-Mo 70723; 6. *Daphnella* sp. St. HK-2. SL=13.7 mm, SW=5.8 mm; 7. *Acteon kawamurai* HABE, 1952. St. HK-3. SL=7.3 mm, SW=4.0 mm, NSMT-Mo 70735; 8a-b. *Cranulilimopsis oblonga* (A. ADAMS, 1860) St. HK-2. SL=11.6 mm, SW=10.9 mm, NSMT-Mo 70746; 9. *Cranulilimopsis oblonga*. St. HK-2. SL=11.3 mm, SW=10.8 mm, NSMT-Mo 70746; 10a-c. *Callanaitis hiraseana* KURODA, 1930. St. CB-2. SL=12.9 mm, SW=15.9 mm, NSMT-Mo 70747; 11a-b. *Dosinia (Phacosoma) abyssicolum* HABE, 1961. St. HK-6. SL=38.1 mm, SW=37.1 mm, CBM-ZM 113949.

## Plate 4

- 1a-b. *Lissostesta japonica* (A. ADAMS, 1861). St. HK-2. SL=1.1 mm, SW=1.7 mm, NSMT-Mo 70703; 2a-b. *Conradia clathrata* A. ADAMS, 1860. St. CB-2. SL=4.4 mm, SW=3.8 mm, NSMT-Mo 70702; 3. *Odostomia tenera* A. ADAMS, 1860. St. HK-3. SL=5.4 mm, SW=2.4 mm, NSMT-Mo 70724; 4. *Chrysallida rufolineata* A. ADAMS, 1863. St. HK-3. SL=3.0 mm, SW=1.5 mm, NSMT-Mo 70725; 5. *Chrysallida pilicata* A. ADAMS, 1860. St. HK-5. SL=3.3 mm, SW=1.5 mm, NSMT-Mo 70726; 6. *Chrysallida pulchella* A. ADAMS, 1860. St. HK-3. SL=2.4 mm, SW=1.2 mm, NSMT-Mo 70727; 7. *Chrysallida punctigera* (A. ADAMS, 1860). St. HK-3. SL=2.8 mm, SW=1.3 mm, NSMT-Mo 70728; 8. *Chrysallida mariella* (A. ADAMS, 1860). St. HK-3. SL=2.0 mm, SW=1.1 mm, NSMT-Mo 70729; 9a. *Eulimella diaphana* (A. ADAMS, 1861). St. CB-2. SL=1.6 mm, SW=0.6 mm, NSMT-Mo 70730; 9b. Protoconch of *Eulimella diaphana*; 10. *Tropaeas strigulata* (A. ADAMS, 1861). St. HK-3. SL=5.6 mm, SW=1.5 mm, NSMT-Mo 70731; 11. *Turbonilla elegantula* (A. ADAMS, 1860). St. HK-3. SL=3.8 mm, SW=1.2 mm, NSMT-Mo 70732; 12. *Turbonilla matunamiensis* OTUKA, 1935. St. HK-3. SL=3.8 mm, SW=1.1 mm, NSMT-Mo 70733; 13a. *Turbonilla speciosa* A. ADAMS, 1860. St. HK-4. SL=4.3 mm, SW=1.0 mm, NSMT-Mo 70734; 13b. Protoconch of *Turbonilla speciosa*.

## Plate 5

1. *Cylichna (Adamnestia) rimata* A. ADAMS, 1862. St. CB-2. SL=9.8 mm, SW=4.0 mm, NSMT-Mo 70736; 2. *Cylichna (Adamnestia) consobrinoides* A. ADAMS, 1862. St. CB-2. SL=15.2 mm, SW=6.1 mm, NSMT-Mo 70737; 3. *Cylichna (Adamnestia) crispula* WATSON, 1886. St. HK-2. SL=2.8 mm, SW=1.4 mm, NSMT-Mo 70738; 4. *Cylichna (Eocylichna) inedita* A. ADAMS, 1862. St. CB-0. SL=4.0 mm, SW=1.5 mm, NSMT-Mo 70739; 5. *Cylichna (Eocylichna) venustula* A. ADAMS, 1862. St. HK-5. SL=4.8 mm, SW=2.1 mm, NSMT-Mo 70741; 6. *Cylichna (Eocylichna) venustula*. St. HK-3. SL=5.0 mm, SW=2.3 mm, NSMT-Mo 70740; 7. *Cylichna (Eocylichna) venustula*. St. HK-3. SL=4.6 mm, SW=2.2 mm, NSMT-Mo 70740; 8. *Cylichna (Eocylichna) involuta* (A. ADAMS, 1850). St. CB-2. SL=7.8 mm, SW=3.0 mm, NSMT-Mo 70742; 9a. *Philine orca* GOSLINER, 1988. St. HK-2. SL=2.5 mm, SW=1.6 mm, NSMT-Mo 70743; 9b. Sculpture of outer surface of shell of *Philine orca*; 10a. *Philine striolata* A. ADAMS, 1862. St. HK-3. SL=1.5 mm, SW=1.2 mm, NSMT-Mo 70744; 10b. Sculpture of outer surface of shell of *Philine striolata*; 11. *Rhizorus opalinus* (A. ADAMS, 1862). St. HK-3. SL=3.0 mm, SW=1.6 mm, NSMT-Mo 70745.

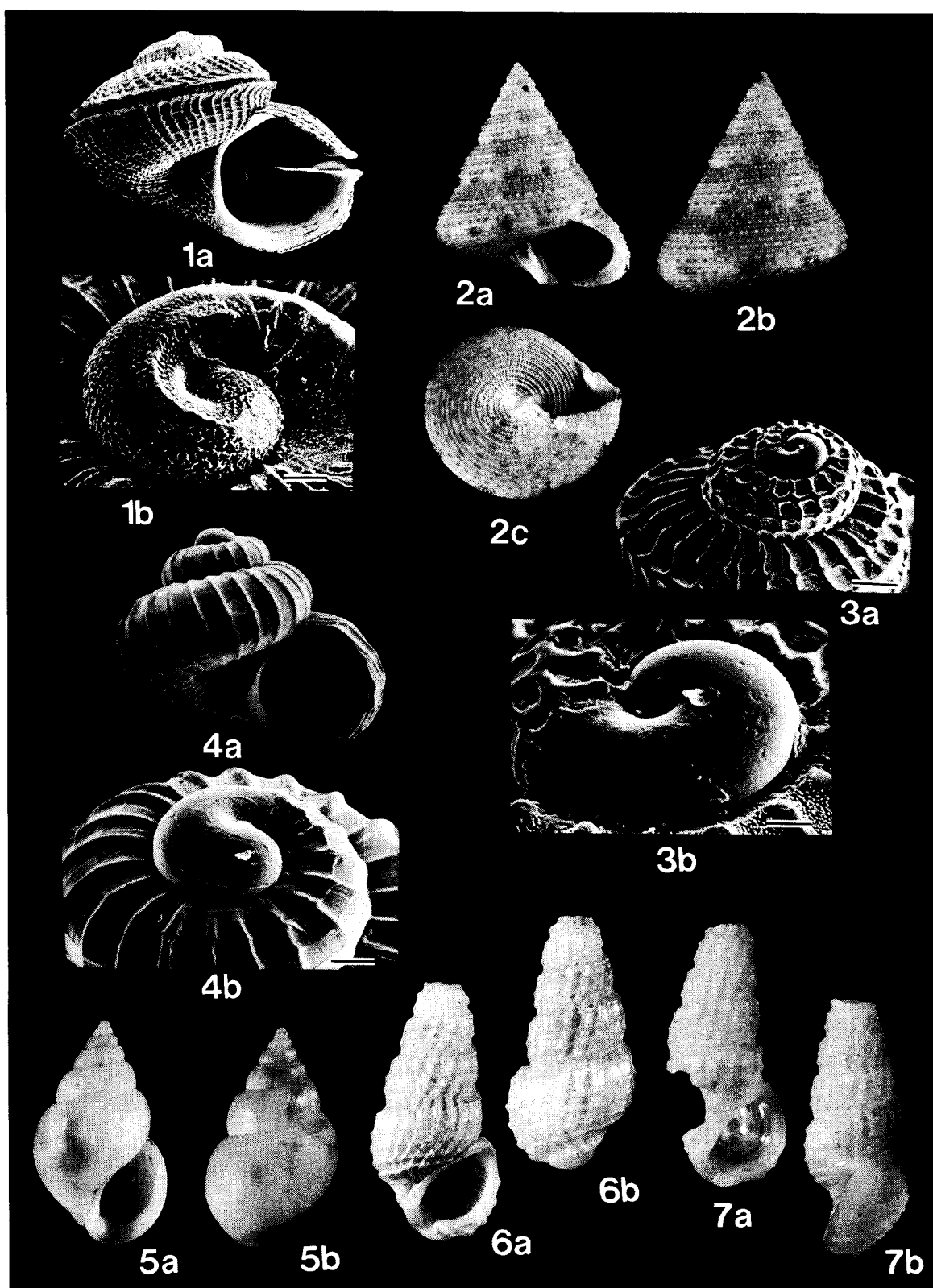


Plate 1

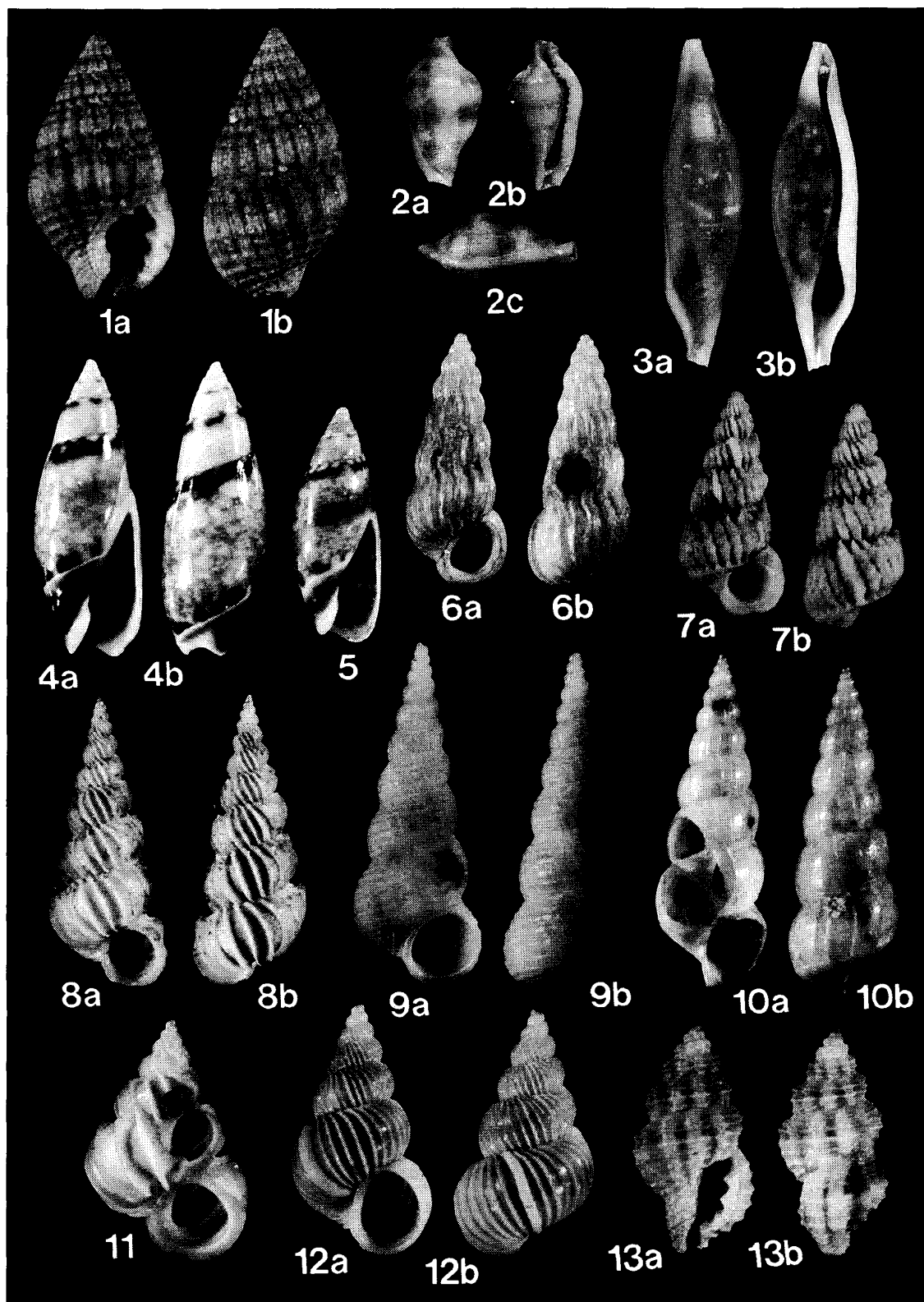


Plate 2



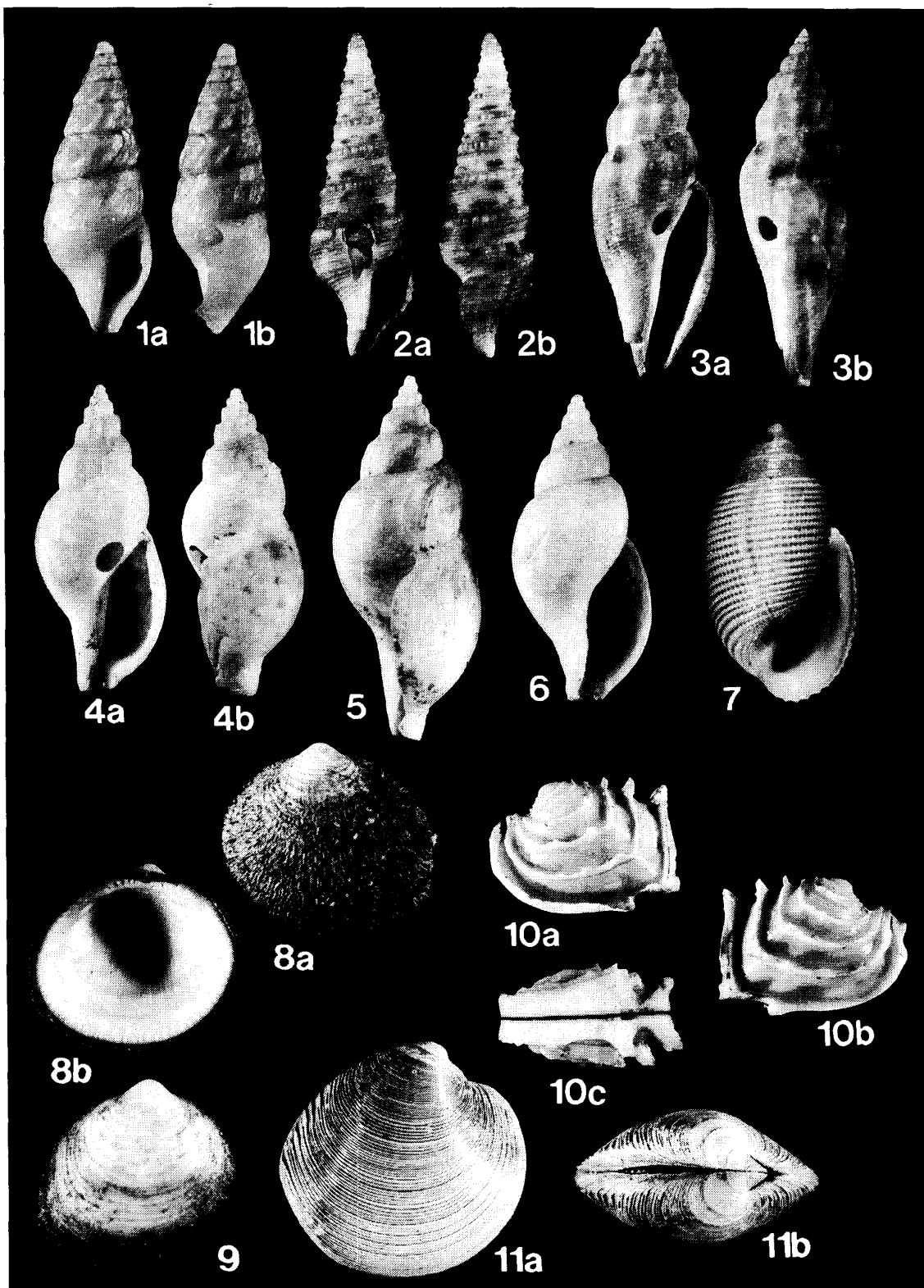


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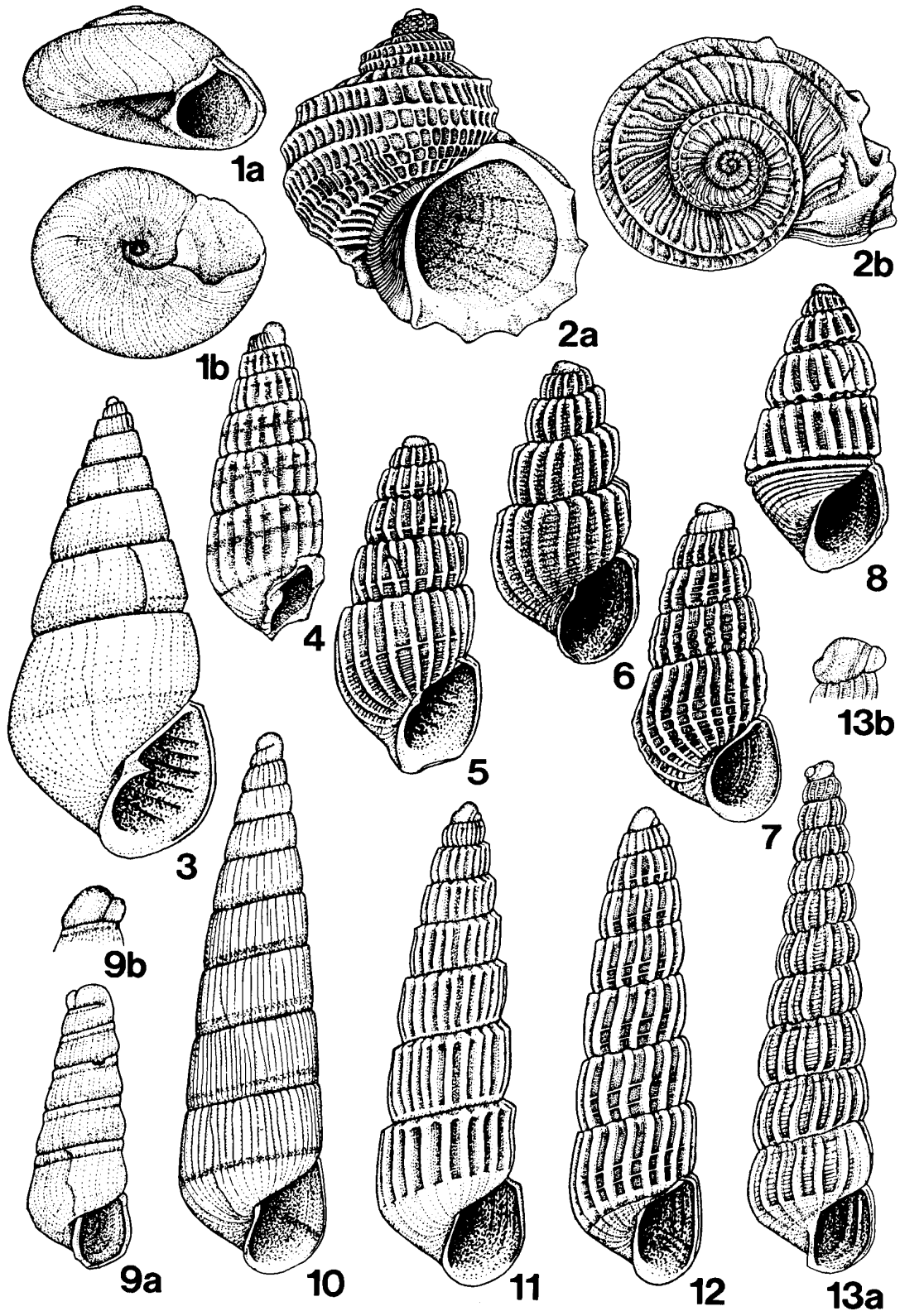


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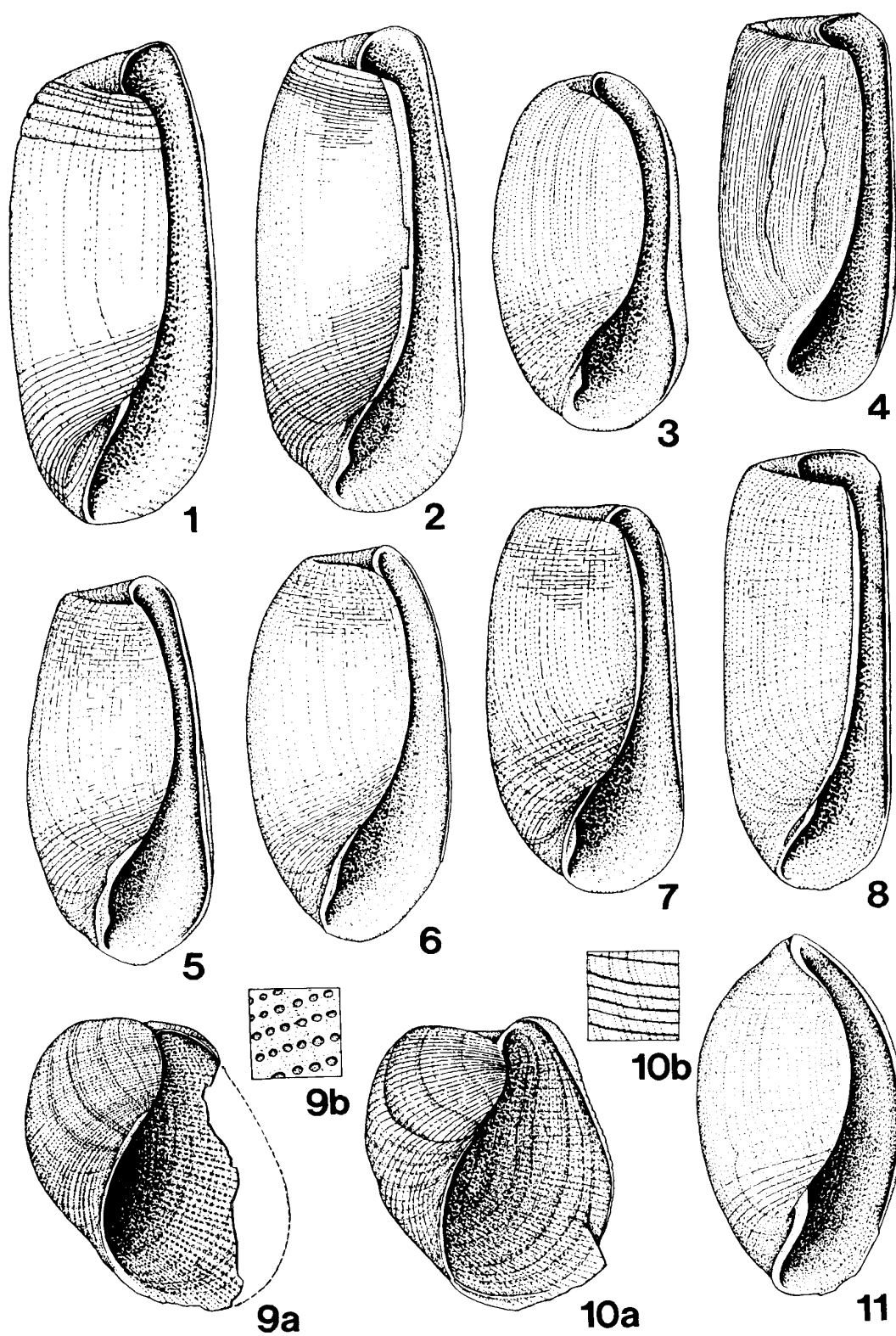


Plate 5